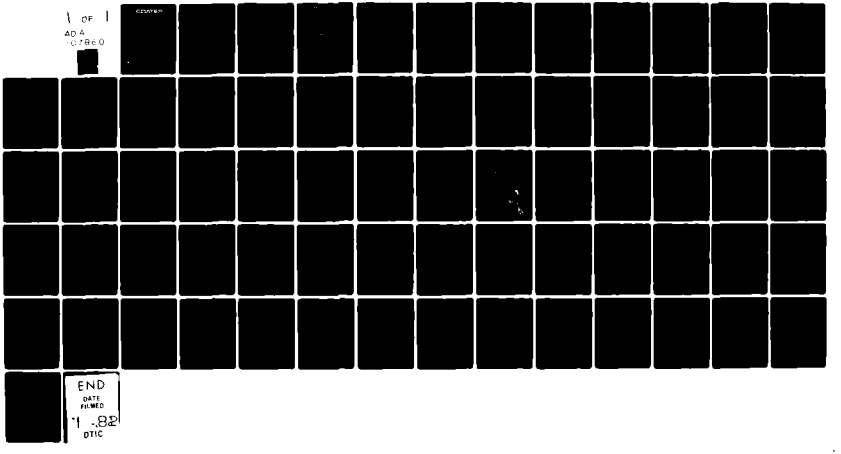
AD-A107 860 COATES (J F) INC WASHINGTON DC F/6 5/3
THE SEARCH FOR SMALL BUSINESSES WITH INVESTMENTS IN METRIC PROD--ETC(U)
JUN 81 H H HITCHCOCK, J F COATES AA-80-SAC-X8604
UNCLASSIFIED NL



(12)

JFCOATES INC.

Report To The U.S. METRIC BOARD

THE SEARCH FOR SMALL BUSINESSES WITH INVESTMENTS IN METRIC PRODUCTION

BY

HENRY H. HITCHCOCK

JOSEPH F. COATES

JUNE 2, 1981

3738 KANAWHA STREET, N.W. WASHINGTON, D.C. 20015 (202) 966-9307

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered) UNCLASSIFIED

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: None	2. GOVT ACCESSION NO.: AD-A107860
3. RECIPIENT'S CATALOG NUMBER:	
4. TITLE (and Subtitle): The Search for Small Businesses with Investments in Metric Production	5. TYPE OF REPORT & PERIOD COVERED: Phase report
6. PERFORMING ORG. REPORT NUMBER: None	
7. AUTHOR(s): Henry H. Hitchcock, Joseph F. Coates	8. CONTRACT OR GRANT NUMBER(s): AA-80-SAC-X8604
9. PERFORMING ORGANIZATION NAME AND ADDRESS: J.F. Coates, Inc. 3738 Kanawha Street, NW Washington, DC 20015	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: None
11. CONTROLLING OFFICE NAME AND ADDRESS: Office of Research, Office of Research, Coordination & Planning, United States Metric Board, 1600 Wilson Blvd., Ste. 400, Arlington, VA 22209	12. REPORT DATE: June 1981
	13. NUMBER OF PAGES: 60
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office): Same	15. SECURITY CLASS. (of this report): Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE: Not applicable

16. DISTRIBUTION STATEMENT (of this Report)

Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

Unlimited

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Metrication, costs, benefits

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A purposive sample of 1161 manufacturing firms were contacted. The purpose was to locate a few small businesses for in-depth analysis of the costs, benefits, problems, and opportunities posed by metrication. The search process itself was worthy of exposition; this report details that search.
Some general findings are: there is a widespread capability among small business to produce metric products but the capability is shallow; unusual or big demands for metric products may be difficult to meet; the investment and extent (cont.)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

20 (cont.)

of conversion for most small businesses is very small and unimportant; developing a metric capability is seen as a routine, unexceptional, necessary cost of doing business; conversion by small businesses is usually the result of demands from existing customers--especially large firms; few small businesses have converted to increase foreign sales.

JFCOATES INC.
3738 KANAWHA STREET, N.W. WASHINGTON, D.C. 20015

Report To The U.S. METRIC BOARD

THE SEARCH FOR SMALL BUSINESSES WITH INVESTMENTS IN METRIC PRODUCTION

BY

HENRY H. HITCHCOCK

JOSEPH F. COATES

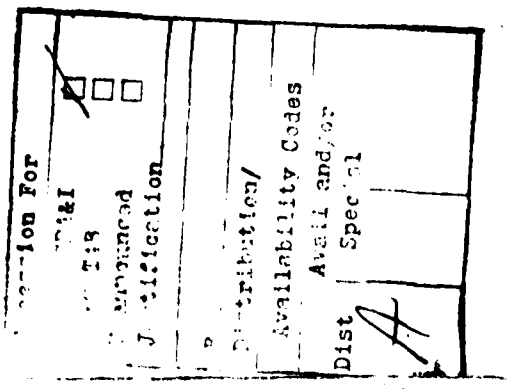
JUNE 2, 1981

PREPARED FOR

UNITED STATES METRIC BOARD
1600 Wilson Boulevard
Fourth Floor
Arlington, Virginia 22209

DISCLAIMER

This report was prepared for the U.S. Metric Board under Contract number AA-80-SAC-X8604. Any opinions, findings, conclusions, or recommendations expressed in the report are those of the authors and do not necessarily represent the views of the U.S. Metric Board.



PREFACE

The metric system of measurement is working its way into all aspects of American life: sports, schools, health care, gasoline pumps, wine and liquor, manufacturing, weather reports, and soft drink bottles. The U.S. Metric Board was established to assist individuals, groups, governments, companies, and others who voluntarily choose to convert to using the metric system. One of their missions is research on how conversion to metric occurs and what its effects are on those who convert and on the nation.

Over the last decade, the effects of metric conversion on small businesses has been the subject of controversy, concern, and conjecture. Enthusiasts for metric argue that conversion would benefit small businesses in two ways. It would expand their markets -- especially export markets. It would also improve business by making production processes more rational. Dissenters argue that conversion is unnecessary and possibly harmful to the large majority of the nation's small businesses. They see the primary benefits of conversion going to the large corporations -- especially the multi-national corporations.

Against this backdrop of controversy, the U.S. Metric Board is fulfilling its statutory mission to find out what happens to small businesses when they convert. This is the second U.S. Metric Board sponsored study of small business. The first project was a ground breaking survey of metric activities and attitudes in small businesses. This study was designed to move beyond the atomic data of the survey to develop holistic, detailed accounts of conversion. The plan was to locate a few small businesses which had made substantial investment in converting to metric. Substantial investment would provide the context for detailed accounts of the costs, benefits, anticipations, problems, and opportunities and results of small business conversions. Part of the plan involved studying a constellation of suppliers and customers of the key small companies. The constellation would extend the holistic analysis outside the key companies and reveal external causes and effects of conversion.

In the first stages of the project the team sought contacts with small businesses for two purposes: (a) to improve the analytical plan through

discussions with successful converters and (b) to locate possible key companies for in-depth analysis. As difficulties arose in locating successful converters and key companies, the search changed. This report recounts how the search progressed and what was found.

The search was revealing and highly productive in an unexpected way. Very few companies qualify for in-depth analysis. However, talking to over 1100 companies revealed a fascinating policy-rich portrait of metric production by America's small businesses.

Several people were instrumental to the work. Marcy Carnavan and Kathryn Rucker contacted many of the 1100 businesses. Teresa Gorman, Lisa Heinz, Andrea Coolidge, Silvia Marinilli, and Grant Prillaman assisted throughout the project. Terry Saunders Parsons was responsible for administration; Bernice Mann produced the report. At the U.S. Metric Board, Gene Visco, Ed McEvoy and Stan Parent were enthusiastic, attentive patrons ever helpful in guiding us through this difficult task. David Freund of USMB helped us find our way through the USMB information files. Mary Foote of Damans Associates was particularly helpful in establishing contacts with respondents to the first small business study. Bruce Kirchoff and Bruce Phillips of the Small Business Administration (SBA), Charles Thiel of the Federal Emergency Management Agency (FEMA), David Goldman of the National Bureau of Standards (NBS), G. Patrick Johnson of the National Science Foundation (NSF), and David Gorin of the American National Metric Council (ANMC) gave indispensable assistance during the search.

TABLE OF CONTENTS

EXHIBITS

SUMMARY

General Finding

There is a widespread capability among the nation's small businesses to produce metric products. However, the investment and extent of conversion for most small businesses is very small and unimportant. Developing a metric capability is seen by most businesses as a routine, unexceptional, necessary cost of doing business. Conversion to metric by small businesses is usually the result of demands from existing customers -- expecially large corporations. Few small businesses have converted to increase foreign sales. The capability developed by small businesses to produce metric products is widespread b: shallow. Unusual or big demands for metric products are likely to be difficult for most small businesses to handle with present capabilities.

Search and Strategy

These conclusions are derived from contacts with 1,161 businesses -- small businesses (868) and the large businesses they supply (293). The purpose of these contacts was to locate a few small businesses for in-depth analysis of the costs, benefits, problems, and opportunities posed by conversion to the metric system. To find small businesses with sufficient activity to warrant extensive analysis of costs and benefits, the study concentrated on small businesses that had made substantial investments in converting to metric. Following the results of previous research and the advice of experts, the study team searched among small manufacturers for manufacturers of hard metric products; they would be most likely to make substantial investments in conversion since they would be purchasing new production equipment to incorporate metric dimensions. The focus on substantial investments eliminated over 90% of small businesses -- wholesale trade, retail trade, service, and other types of companies.

The search strategy was evolutionary and convergent. In looking for substantial investors in metric conversion, many sources were used: the metric literature, trade press, trade and business associations, informed observers, large corporations, and companies contacted in previous USMB research. A comprehensive and intensive search was made of the industrial base of Pennsylvania and Maryland -- states with many, diverse industries.

Number and Investments of Metric Small Businesses

From this directed search for small businesses making substantial investments in metric conversion, only a handful of companies (a) considered their investment substantial, and (b) spent over $10,000 in converting to metric. Specifically:

- Three companies spent over $10,000 on conversion and considered the investment substantial; another four spent over $10,000 but did not see the investment as substantial. These seven represent less than 1% of all the small businesses contacted -- less than 3% of all the metric producing small businesses contacted.

- Three of every ten small businesses contacted made hard metric products. Most of these companies made insubstantial investments in conversion -- by their own estimate and in terms of the $10,000 threshold. Several companies had always produced metric products.

- The other seven out of every ten small businesses contacted continue to produce using only customary dimensions.

Findings on the Conversion Process

In the course of contacting these 1,100 companies, a number of interesting and important findings concerning conversion emerged:

- Most small businesses convert part of their production to metric because of customer demands. Usually the customer is a large corporation that has converted to metric.

- Few companies convert more than a very small percentage of their production to metric.

- Most companies respond to metric requests by converting the request into customary units and producing it using conventional machines.

- Conversion has cost small businesses very little. Most companies have spent less than $5,000, often around $1,000, converting to metric. Low cost electronic dual readouts have made conversion easy and relatively inexpensive.

- Conversion occurs on the margin. Most businesses do not shift to metric all at once. As new machines are ordered or new tools bought, small businesses purchase tools and machines that can produce in both metric and customary units. Few make major purchases solely for metric production.

- Conversion to metric is often spurred by the need to repair, modify, or replace foreign machinery. In a number of industries such as mining, candy machinery, and electron microscopes, all machinery is made overseas. To fix this metric machinery, local suppliers and service companies must begin to deal with metric dimensions.

- Metric activity is greatest in the machine and fabricated metal products industries -- industries making products for other industries. Metric has made few inroads to the highly diffuse consumer industries, such as food, apparel, leather goods, and furniture.

- Large corporations often assist their small business suppliers in meeting their metric demands. It is in both parties' interests.

- There is little awareness of or interest in sector planning related to metric conversion. Conversion occurs on an individual company level; few companies know of others in their area or their industry that have converted to metric.

The portrait drawn here is one of a widespread but shallow capability to produce to metric dimensions. How this thin capability, developed incrementally, would respond to a major surge in the demand for metric products is unclear.

Interpretation

The importance of small businesses to metric conversion has been highlighted repeatedly -- in Congressional reports on metric, in the language of the Metric Act of 1975, in the inclusion of small business representatives on the U.S. Metric Board, and in the establishment of a Small Business Advisory Group of the American National Metric Council. The effect of conversion on small businesses has been a central concern in the metric debate. To characterize the past decade's debate, at one extreme stand the metric enthusiasts who see benefits to all in a rapid and complete shift to metric production. At the other extreme are the hard-line traditionalists who see little justification for metric conversion -- an unnecessary, non-competitive waste of resources. This section discusses the implications of this study's findings for the various issues that separate these two positions.

The issues relate to:

- The extent of conversion;
- The cost of conversion;
- The nature of conversion;
- The motivation for conversion;
- The equity of conversion;
- The pace of conversion;
- The future of conversion.

Exhibit 1 illustrates the implications of the study findings on each of the seven issues. The dart (▲) on the scale indicates the pole of the controversy the findings favor. For example, if the dart is near the enthusiast position, as in the case of costs, the findings favor the enthusiasts' interpretation of that particular issue. The findings support both positions but on different issues. On several issues they come down close to the middle. The following describes the rationale behind the position of each of the darts.

Extent of Conversion

The enthusiasts argue that conversion is occurring in all sectors of the economy. The hardliners argue that metric has seen its heyday -- the flurry of activity surrounded the passage of the 1975 Act; the level of activity has remained constant or declined since then. The study's findings indicate a widespread capability to produce metric products for a wide range of manufacturing industries. However, these industries are concentrated in the metals and machinery related manufacturing industries. Many consumer industries remain customary.

Cost of Conversion

The hardliners argue that the costs of metric conversion would be a substantial drain on the limited resources of the small business. Enthusiasts cite the experience of larger companies in stating that the costs of conversion are much less than most businesses estimate. From the responses of the 257 metric small businesses, the costs of conversion are unimportant -- primarily because the extent of conversion is so small. Most companies feel that a full scale conversion is unnecessary and prohibitively costly.

EXHIBIT 1

FINDINGS ON THE ISSUES CONCERNING METRIC CONVERSION AND SMALL BUSINESSES

Issue	ENTHUSIASTS		HARD LINERS
Extent of Conversion			
	Widespread in many industries	x ▲ . . . 0 x	Moving slowly; few industries
Cost of Conversion			
	Trivial costs with caution	x ▲ . . . 0 x	Possible major economic losses
Nature of Conversion			
	Hard conversion of products and processes in many areas	x . . . . 0 . . . ▲ x	Dual measurement; conventional measurement clearly dominates
Motivation for Conversion			
	Voluntary search for new markets - home and abroad	x . . . . 0 . . . ▲ x	Involuntary conversion forced by demands from large corporations.
Equity of Conversion			
	All will benefit	x . . . . ▲ x	Multinationals benefit at the expense of small businesses.
Pace of Conversion			
	Rapid and complete	x . . . . ▲ x	Ad-hoc, as needed
Future of Conversion			
	Complete conversion in the near future	x . . . . ▲ x	Limited conversion over the long term; consumer never converts

Nature of Conversion

For the enthusiast, conversion to metric implies an extensive and complete shift of all measurement to metric dimensions; conversion is adopting a new language. For the hardliners, conversion is more like bilingualism; metric should be used only when it is asked for. The primary measurement system in the U.S. is customary and will continue to be so for the indefinite future. According to the study, conversion most closely approximates the hardliner position -- few companies have converted more than a negligible amount of their production to metric. Much of that production is done using customary units.

Motivation for Conversion

According to the hardliners, the only reason small business will convert to metric is if it is forced to by government or big business; small businesses have little interest in export trade -- the key force behind conversion. Given their view regarding the unnecessary costs of conversion, hardliners feel conversion would definitely harm small businesses. The enthusiasts feel small businesses will voluntarily convert when they see the rest of the industry converting; this would be easiest to accomplish if there were a plan and a mandate for change. Short of that, the smart small business person will see the value in converting to improve domestic as well as export business, according to the enthusiast. The results of the search indicate that most small businesses do not convert until they are forced to by the demands of their customers -- usually large businesses. Few of them are involved or interested in export trade.

Equity of Conversion

The enthusiasts argue that converting small businesses to metric will benefit all -- large business, consumers, small business -- by improving the nation's export position. Also, once the initial problems are overcome, the conversion will make calculations simpler. To the hardliner, the conversion to metric will benefit big business, especially the multinationals. It will hurt labor, small business, and the consumer as they absorb the necessary costs of conversion. The findings on this issue are ambiguous. Conversion clearly helps large business. However, as it occurs at present -- gradually and at low cost -- it is not hurting small business, labor, or consumers.

It is not necessarily benefiting these groups either. Few small businesses use metric to expand their markets or to rationalize their production processes. One element promoting equity in conversion has been the active, albeit self-interested, assistance offered by big businesses to the small business converter.

Pace of Conversion

The hardliners argue that conversion to metric should be completely voluntary; in addition, it should be undertaken on an as needed basis, that is, as needed by the individual company. The enthusiast would prefer a mandate for conversion to metric measurement to ease the problems of transition and reduce inequity. Short of a mandate the enthusiast feels that the industry should cooperate and plan for conversion. The findings of this study indicate conversion is occurring on an ad hoc, unplanned basis as demands from existing customers warrant the conversion. There does not appear to be a shared image in any of the industries of what the future holds for metric. There is also little knowledge of what others in the industry are doing to convert to metric.

The Future of Conversion

The enthusiast sees a metric America in the near future. The pressures of an all metric world make conversion of the U.S. inevitable. All sectors of the economy, including consumer goods, will convert. Hardliners insist that America remains powerful in the global economy and therefore will not be forced to convert to metric by the actions of other nations. The only ones who will convert are the large multinationals who sell to foreign customers. At most, according to hardliners, conversion will only occur in basic and intermediate production, not in consumer goods. Again, the results are ambiguous on this point. Some contacts see conversion as inevitable; for others, it was a fad whose time has come and gone. Most of the conversion has been in basic and intermediate industries -- small as well as big businesses have made the change. The future -- especially as reflected in the perceptions of the small business persons contacted -- is uncertain.

Policy Implications

The metric debate is typical of one kind of public policy controversy in which a major action or development is possible. Large and powerful interests mobilize and take strong positions, but there is a dearth of solid policy-oriented information. The result is a tendency toward extreme intransigent positions. The research shows that no extreme is justified. Conversion is neither as extensive nor as voluntary as enthusiasts would like to believe. It is not as costly or as inequitable as the hardliners claimed.

The present policy of drift has developed a broad but shallow metric capability among America's manufacturers. This policy has engendered little cost and few problems for the nation's small businesses. They are managing quite adequately in the present situation. The policy of drift is not doing the nation any visible harm. However, it is not doing the nation any good.

Major shifts in the demand for metric products are not likely to be handled by present capabilities. Forcing such changes through procurement or government mandate could engender the often cited problems of costs and inequities. However, without a significant push, the metric capability of the nation's small businesses may not develop beyond its current state.

While further understanding of the effects on small business of conversion to metric would be useful, perhaps more in the public interest would be pursuing positive policy questions such as:

- Can metric conversion assist the reindustrialization of the American economy?
- Can accelerated metric conversion develop more extensive and diversified export trade and better balance of payments?
- Is accelerated metric conversion a potential benefit for the economic health of the nation?

The fundamental question remains unanswered and ignored. What is the desired future of metric conversion in the United States?

INTRODUCTION

The metric system of measurement is gaining acceptance in many areas of American life -- from schools to missiles, from weather reports to liquor bottles, from pills to gasoline. As the nation adopts the metric system, problems arise. That is the nature of change. Should there be only one official measurement system? What about the costs of dual inventories? What is the effect of conversion to metric on worker job security? On advancement? On collective bargaining? Who pays for conversion -- The consumer? The taxpayer? The corporations which convert? How should they pay? What is voluntary conversion?

These and other issues have been raised in the decade of debate over metric conversion in the U.S. A matter of intense concern has been the consequences of conversion for the nation's small businesses. Enthusiasts of metric conversion argue that metric conversion would be inexpensive and would open new markets, here and abroad. Enthusiasts argue that conversion should be planned and executed within a definite period, so that no one will suffer unduly from conversion. Others argue that conversion is unnecessary for the majority of America's small businesses -- locally oriented retail and service businesses such as dry cleaners, grocers, gas stations, plumbers, clothing stores, and cab companies. Antagonists see metric as most likely to benefit large corporations -- especially multinational corporations. Labor, small businesses, and consumers would in effect subsidize the conversion benefits for these larger corporations. A factor in the argument against conversion is the belief that the costs of conversion are much larger than the enthusiasts admit.

In discharging its statutory responsibility, the U.S. Metric Board has sponsored research to improve our understanding of the nature and effects of metric conversion among small businesses. This is the second study the USMB has undertaken on this subject. The previous study undertaken by the Board on this subject was a survey of metric activity and attitudes among small businesses. This study shifts the focus from the broad survey to developing a detailed understanding of the costs, benefits,

anticipations, problems, and opportunities and outcomes of conversion. An accurate picture could be used to develop policies for easing any widespread big problems of metric conversion.

Before detailed analyses of the conversions of small businesses to the metric system were developed, the study team wanted to interview small businesses which had converted to metric. While there are a large number of small businesses that produce products to metric dimensions, the study team was looking for a particular type of small business converter -- one that had made a substantial investment in converting to metric. A company with a substantial investment would be the best subject for an in-depth analysis of costs and benefits of conversion. By definition, this meant a small manufacturing firm making hard metric products -- products designed to metric not customary measurements. This report describes the evolving search for small businesses making substantial investments in converting to metric, the reasons it took the paths it did, and what was found at each step.

The results of this search are highly informative for research and policy. Through contacts with over 1100 companies an image of small business involvement with metric has emerged that is sharply at odds with previous interpretations, but consistent with previous findings. The results also reduce the ambiguity of previous research. The results are not the final word. They merely report where the nation stands as a result of past and current policies. The information should stimulate a new interest in metric policy based on an understanding of how conversion happens and what effects occur.

The report is organized in two major sections. The Background section describes the purpose and rationale. A key point in this discussion is a description of the specific universe contacted and why that particular slice of the small business community was chosen. The second section, Searches, describes the several searches and their outcomes.

BACKGROUND

The Project Strategy

The research plan was to extend the analysis begun in a previous survey which covered:

- the level of conversion among small businesses in manufacturing, wholesale, and retail trade construction and transportation
- factors related to the decision to convert
- the types of assistance sought while converting
- the ways small businesses made their views known about metric conversion to public policymakers
- views of small businesses on the future of metric conversion.

That survey, collecting data on 1100 companies around the country, concluded that a modest but significant amount of metric production had been developed with few problems as a result of demands from the firm's customers or suppliers.*

Where the previous survey had yielded atomic or highly discrete data on the state of metric, the present research would provide integrated, holistic accounts of conversion experiences. The purposes of this project according to the USMB solicitation are:

- an assessment of the actual costs and benefits of conversion experienced by small businesses,
- a detailed review of the alternative forms of representation ** (voices or channels) available to the small business community.

On the issue of costs and benefits, the solicitation further requires the analysis to:

- determine the direct and indirect, monetary and non-monetary costs and benefits to selected small businesses and industries which have converted to the metric system. Of major interest are conversions to hard metric units, that is, products made to metric dimensions, with lesser interest in cases of soft conversion (metric labeling of products made to customery units). Costs include cost and availability of credit.

---

* Damans and Associates, Survey of Small Businesses: Issues in Metric Conversion and Planning. Prepared for the U.S. Metric Board, December, 1980.

** This report covers the search for companies to contact regarding the costs, benefits, problems, and opportunities of conversion. Research results on representation have been described in memoranda to the USMB.

The study team proposed a research plan to meet these goals based on describing the conversion experiences of clusters of small businesses. These clusters would consist of:

- a relatively large-size small business which has undergone hard metrication, and which was not previously involved in metric-related activities, e.g., not a scientific instrument supplier;
- from the suppliers to that company, a small business impacted by the hard metrication;
- on the output side, customers of the company, potentially or in fact, impacted by hard metrication.

Exhibit 2 shows the cluster concept. For each cluster, the research would develop: (a) a qualitative description of conversion to metric, including the way the decision was made, how the conversion took place, who was involved, the kinds of problems that occurred, the kind of help sought and received, and the implications of conversion for the business; and (b) a quantitative accounting of the costs and benefits of conversion that would look in depth at the microeconomics of the many decisions that comprise the conversion to metric production.

Underlying the study approach were several assumptions, including:

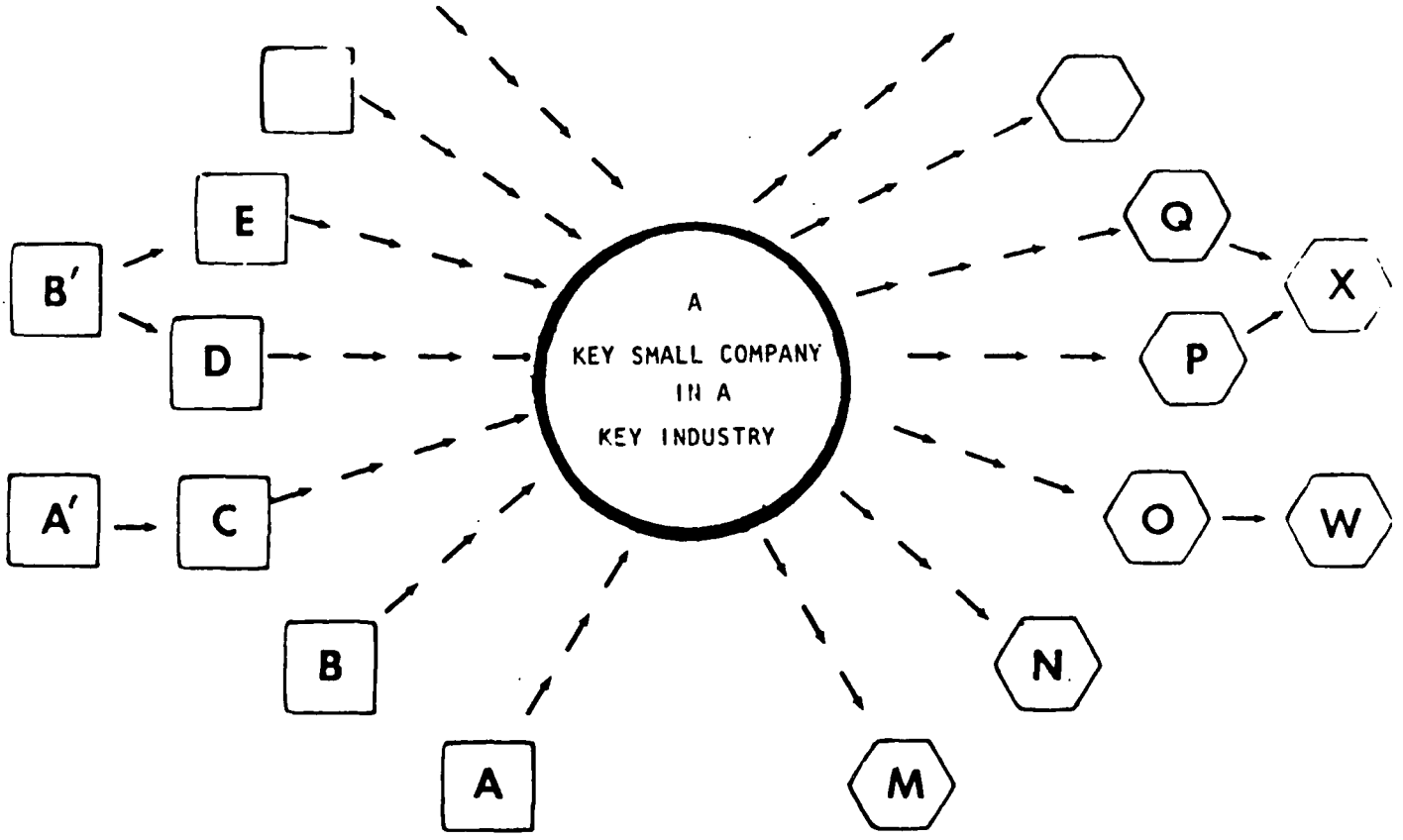
- the most likely place to find costs and benefits of conversion is in most companies producing hard metric products; dual labeling (soft conversion) is not likely to involve significant costs or benefits.
- some businesses have made substantial investments in converting production to hard metric production.
- these businesses are easily identifiable and numerous;
- these businesses will be willing to talk in depth and detail about their conversion experience.

To refine the analytical approach the first step in the plan was to find and interview several companies which had successfully converted to hard metric production. At the same time the project team began to look for companies that might qualify as key companies for in-depth analysis of clusters of small businesses.

It soon became obvious that the project team overestimated the number of companies investing in converting to metric and the size of their

EXHIBIT 2

COMPANY ELEMENTS OF AN INTEGRATED ACCOUNT OF A SECTORIAL CONVERSION TO METRIC



investment. While the team got valuable information from the people it talked with, it was unable to find successful converters or to locate possible key companies easily. As a result the work expanded into an extensive search. Before describing the searches and the results, it may help to clarify what the team was looking for.

The Goal

To develop detailed accounts of the conversion experiences of a few small businesses, it was necessary to locate companies for study. Several criteria for sorting possible candidates for in-depth analysis were used. Some criteria -- small, independent -- were given by the nature of the project -- a study of small businesses. The other criteria were to ensure the analysis focused on companies likely to have a useful story to tell. Unless a company has converted from customary to metric and made a substantial investment -- by its own account as well as the judgement of the project team -- it is unlikely to have an experience rich enough to warrant in-depth analysis. As stated in the solicitation, substantial investments were more likely among small manufacturers of hard metric products. The following describes the criteria used for locating possible key companies in more detail:

Small. The research focuses on the effect of conversion to metric on small businesses. After discussions with the U.S. Metric Board and the Small Business Administration, 500 employees were chosen as the upper limit on the size of a small business. Over 95% of all businesses in the United States have fewer than 500 employees. Some researchers use 100 or fewer employees as a criterion for small business. The 500-employee limit made finding small business converters with substantial investments more likely.

Independence. Based on advice from the U.S. Metric Board staff and the American National Metric Council (ANMC), subsidiaries of larger businesses were not considered as small businesses. In addition, small businesses which were forced to convert to metric by the BATF decision on liquor and

wine bottling or by the Department of Defense NATO related purchases were not investigated. The focus was on the independent small business which chose to convert to metric. The team deferred contacting small businesses closely tied to one large business that had converted to metric. The work plan called for investigating the effects of a small business's conversion on a small business supplier and a small business customer. If metric conversion is solely the result of a large company's demands, it would be more difficult to carry out the work plan. This aspect of the independence criterion was relaxed later in the search.

Converted. The project team was interested in companies which had changed part or all of their operations from using customary measurements to metric measurements. Companies which had always produced metric products, even if their volume had increased, have fundamentally different conversion experiences from companies that had switched from all customary to partial or total metric usage.

Significant investment. To be useful to the analysis, a small business should have made a substantial investment in converting to metric. To assess the size of their investment, the project team asked if they thought the investment was substantial, and if the investment was a significant corporate decision. Where possible, cost estimates were sought. Often, ball-park figures, such as over $5,000 but less than $10,000, or less than $50,000 but more than $10,000 were given. There was no fixed idea in the project team of how large a substantial investment was. Initially $50,000 was chosen as a threshold for a substantial investment in converting to metric. The most useful comparison is with capital expenditures, since metric conversion is an investment in production capability. If one assumes conversion occurs over a 5 year period, $50,000 represents between 4% and 50% of the average five year capital expenditures for companies in the industries covered by the search. In the machinery industry, it is 25%; in the rubber and plastics industry, it is 10%. The reader may want to make an independent judgement about the appropriate threshold for substantial investment.

Exhibit 3 shows the number of small business establishments, the total annual new capital expenditures for all small business establishments, the average annual new capital expenditures per small establishment, and the average five year capital expenditures per small business establishment for each of the major industry groups contacted. The reasons these 11 major industry groups were chosen are explained below (see Exhibit 6, p. 24).

After contacting a large number of companies in various industries, it was clear that $50,000 was far higher than most expenditures. Most expenditures were running to $1,000. The threshold was lowered to $10,000 -- representing between 0.5% and 10% of an establishment's average five year expenditures on new capital equipment. It was also a number that seemed significant to the people contacted.

Investment tied to conversion. The relevant investments for this analysis are costs of changing over part or all of the company's operations to the metric system. Continuing costs of running a metric business except as they differed from the costs of running a conventional business were not relevant. For example, if an industrial fastener distributor changed part of its line to metric, the costs of dual inventory would be considered an investment in converting to metric, as would the costs of converting the catalogs, educating the personnel, and changing the billing procedures. However, the costs of the inventory itself would not be considered an investment because this is a normal, required cost of doing business.

Asking companies whether they had made substantial investments in converting to metric, the team was careful to ask whether the costs mentioned were directly related to developing a metric production capability. For example, many companies have bought new machinery to upgrade their business. Often this new machinery has dual measurement capability. The machine was not bought for the metric capability; it was an additional or optional feature. Thus the cost of the machine should not be considered a metric expense, only the marginal cost of the metric capability (if there is any such

EXHIBIT 3

AVERAGE NEW CAPITAL EXPENDITURES FOR MAJOR INDUSTRY GROUPS

MAJOR INDUSTRY GROUP	A. NUMBER OF SMALL ESTABLISMENTS	B. TOTAL ANNUAL NEW CAPITAL EXPENDITURES: ALL SMALL EST. ($1,000)	C. AVERAGE ANNUAL NEW CAPITAL EXPENDITURES: PER SMALL EST. (B/A)	D. AVERAGE 5 YEAR NEW CAPITAL EXPENDITURES: PER SMALL EST. (C x 5)
PAPER AND ALLIED PRODUCTS	6,321	$1,371,800	$217,022	$1,085,110
CHEMICALS AND ALLIED PRODUCTS	11,815	4,432,500	375,158	1,875,740
RUBBER AND MISC. PLASTIC PRODUCTS	11,754	1,127,000	95,882	479,410
STONE, CLAY, AND GLASS PRODUCTS	17,568	1,516,400	86,316	431,580
PRIMARY METAL INDUSTRIES	6,988	1,212,600	173,526	567,630
FABRICATED METAL PRODUCTS	33,322	1,895,600	56,887	284,435
MACHINERY, EXCEPT ELECTRICAL	47,460	1,957,000	41,234	206,170
ELECTRICAL AND ELECTRONIC EQUIP.	14,248	988,000	69,350	346,750
TRANSPORATION EQUIPMENT	9,677	596,500	61,641	308,205
INSTRUMENTS AND RELATED PRODUCTS	7,270	340,100	46,781	233,905
MISCELLANEOUS MANUFACTURING	17,157	328,000	19,117	95,585

* Small establishments refers to those with fewer than 500 employees. The figures for numbers of companies differ from Exhibit 6 because the data are from Census.

Source: U.S. Bureau of the Census, 1977 Census of Manufacturers (Washington D.C.: U.S. G.P.O., April 1981): Table 4, General Summary.

cost). On the other hand, purchases of metric tools and dies are clearly tied to metric conversion.

Hard metric products. Given the desire for companies which had made substantial investments in metric, companies which produce goods in customary dimensions and label them in metric dimensions (soft conversion) were not included. Companies making products designed to both metric and customary dimensions (hybrid conversion), were included. Many manufacturers get orders in metric dimensions (often with conversion factors), convert these dimensions to customary measurements, produce the products, and label the products solely in metric dimensions. The product is designed to metric dimensions but produced using customary equivalents of metric dimensions. The intention was clearly to produce a metric product; in doing so, the company showed a capability to produce metric products. The fact that the process is customary does not obscure that fundamental fact. The team included a product produced in this fashion under hard metric products.

In focusing on hard metric products, the universe was limited to the portion of small businesses manufacturing products for consumer use or use by other industries. Concentration on the manufacturing sector (Standard Industrial Classification Codes 19-39) is supported by the first small business survey. The three major groups of converters were retail trade (SIC 52-59), wholesale trade (SIC 50-51), and manufacturing. Of those three, only manufacturing involves production of hard metric products and the related substantial investment in converting to metric.

Success. From the outset the study was committed to investigating the costs and benefits of completed conversion to metric. The purpose was to identify the implications of all aspects of conversion when it was completed. We did not want to confuse the analysis of costs and benefits with all the different factors that could have been related to an unsuccessful attempt to convert to metric. As it turned out, only a half dozen of the 868 companies contacted complained about losing in attempting to convert to metric. As analysis indicates, success was not a strong sorting criteria.

Not previously studied. Initially, the study plan was to concentrate on areas that had not been covered by the previous surveys of large and small businesses for the USMB. As it became increasingly difficult to locate small business converters, the results of the previous survey were used for leads on possible converters. Use of this survey is described below.

To summarize, the study team was looking for companies:

- with under 500 employees;
- independently owned, i.e., not subsidiaries or divisions of large corporations;
- which had once produced products wholly in customary units;
- are now producing some products to hard metric dimensions;
- have made substantial -- by their own account and judgement -- investments in converting;
- had completed conversion successfully;
- had not converted under pressure from one large corporate customer;
- and had not been studied before by the USMB.

As the search progressed, some of these criteria were relaxed.

The Universe for the Study

Concentrating on small businesses producing hard metric products excluded a large part of the small business population of America. But, manufacturers are the most likely to have made substantial investments in conversion.

According to IRS statistics, there were 14.5 million businesses in the United States in 1976. Three out of every four of these were proprietorships -- many part-time individual businesses such as consulting, delivery services, child care, etc. Statistics from major commercial business listing firms -- Polk and Dun and Bradstreet -- placed the total

number of business establishments* in the U.S. between 4 and 6 million. The Bureau of the Census' County Business Patterns (1977) gives the total number of establishments at 4.292 million. The analysis used the 4 million establishments cited by the County Business Patterns and Dun and Bradstreet as the core business population of the U.S. Exhibit 4 summarizes the differences between the various counts of business establishments in the United States; the exhibit breaks down each count into the major divisions.

Research by Brookings Institution for the Small Business Administration using the Dun and Bradstreet Market Identifier File (DMI) provided detailed breakdowns on the number, size and types of business establishments. The July 1980 data from Brookings lists the total number of business establishments in the United States at 4,089,535. These are establishments which have applied for credit or have been identified by Dun and Bradstreet's network of reporters. The DMI count is quite close to the County Business Patterns census of business establishments. It is particularly comparable in the count of small establishments, therefore the DMI file was considered useful for studying small businesses. **

According to the DMI file, more than 99% of business establishments have fewer than 500 employees (4,074,981); only 14,544 businesses have 500 or more employees. The numbers are not much different when using 100 employees as the cutoff. Business establishments with fewer than 100 employees comprise 97.7% of the total: 3,995,328 establishments.

---

* Establishments are the basic unit for the collection of most of the data on businesses by the U.S. Government. A single business can have several establishments -- plants, branch offices, service centers, etc. In 1976, there were 4.3 million establishments but only 3.75 million businesses. As one would expect the ratio of establishments to businesses increases with the size of the business. For businesses with fewer than 50 employees the establishments were one per company. According to the 1972 Census of Manufacturers, the ratio for businesses between 50 and 99 employees was 2 establishments for every company, for companies with 100 to 249 employees 3:1, and for businesses with between 250 and 499 employees 6:1. For companies with 1000 to 2499 employees the ratio was 47:1. This paper uses establishment numbers to give a general sense of the proportions of the segments of the small business population. For this purpose the distinction between businesses and establishments is not critical.

** Bruce Phillips, "A Comparison of 3 Establishment-Based Data Sources" Office of Economic Research, Office of Advocacy, Small Business Administration, mimeo, no date.

EXHIBIT 4

Comparisons of Total Number of Establishments and Taxpaying Units by Major Division

Major Division	Number of Establishments						
	County Business Patterns (1977)	Dun & Bradstreet (1978)	R.L. Polk and Co. (1978)	Statistics of Income (1976) (Proprietors)	(Partners)	(Corporations)	(Total)
Agriculture, Forestry, Fisheries (01-09)	44,997	102,072	67,489	3,470,438	121,337	56,280	3,648,055
Mining (10-14)	27,755	33,340	16,223	59,732	17,812	14,242	91,786
Construction (15-17)	439,381	553,839	432,969	962,713	60,390	191,219	1,214,322
Manufacturing (20-39)	327,850	407,383	336,201	223,148	30,767	217,354	471,269
Transportation, Communication, Public Utilities (40-49)	166,465	163,919	164,181	345,679	16,860	80,701	443,240
Wholesale Trade Retail Trade (50-59)	375,077 1,263,377 1,638,454	1,742,254	468,372 1,733,127 2,201,499	2,282,288	195,014	614,632	3,091,934
Finance, Insurance Real Estate (60-69)	413,128	289,559	472,511	826,859	446,988	411,846	1,685,693
Services (70-89)	1,233,652	861,619	2,757,026	3,153,115	207,248	435,672	3,796,035
Government (90-99)	-	15,642	20,803	-	-	-	-
Total	4,292,132	4,169,627	6,468,902	11,358,235	1,096,441	2,023,647	14,478,323

Sources: U.S. Dept. of Commerce, Bureau of the Census, County Business Patterns, U.S. Summary Table 1B, Issued 10/79; Dun and Bradstreet *Market Identifier File, unpublished data, 1979.* R. L. Polk and Co., "Polk Catalog of Mailing and Prospect Lists." Internal Revenue Service, Business Income Tax Returns, (1976), tables 1.1, 2.1 (1976); Corporate Income Tax Returns (1975), Table 1. These were the latest available data as of 5/80.

Note: Detail may not add to total due to nonclassifiable industries.

Using the 500 or fewer employees definition, Exhibit 5 summarizes the percentage of small businesses accounted for by each of the major industrial divisions. The majority of small businesses are in retail trade (31.5%) and services (21%). The next tier consists of construction (13.6%), wholesale trade (11.2%) and manufacturing (9.9%). The other 4 categories account for the remaining 12.8%; the finance, insurance, and real estate category comprises over half of that remainder.

Most small businesses are outside the scope of this study. Trade, services, financial, utilities, and extractive industries may use but do not produce metric products. The focus here is on small businesses that manufacture products. (See shaded portion of Exhibit 5.) These are the small businesses falling in Standard Industrial Classification (SIC) * codes 20 to 39 covering such diverse activities as food production, textiles, electrical machinery, leather products, instruments, and chemicals. According to the DMI file, there are 407,380 manufacturing establishments. Of those, 400,918 (98.4%) have 500 or fewer employees. Using 100 or fewer employees as the cutoff, the numbers do not change very much; 368,458 (90.4%) manufacturing establishments have fewer than 100 employees.

Within the manufacturing sector, the small businesses are distributed evenly across the different industries. Exhibit 6 gives the number of establishments with fewer than 500 employees in each industry group (2 digit SIC code) within manufacturing. The percentages refer to the portion of the total number of manufacturing establishments with fewer than 500 employees. Machinery (14.9%) and printing and publishing (14.6%) have the most establishments. Third is fabricated metal products (9.6%) followed by the clustering around 5-7%: lumber and wood, apparel and textile products, food and kindred products, miscellaneous manufacturing, and stone clay and glass products.

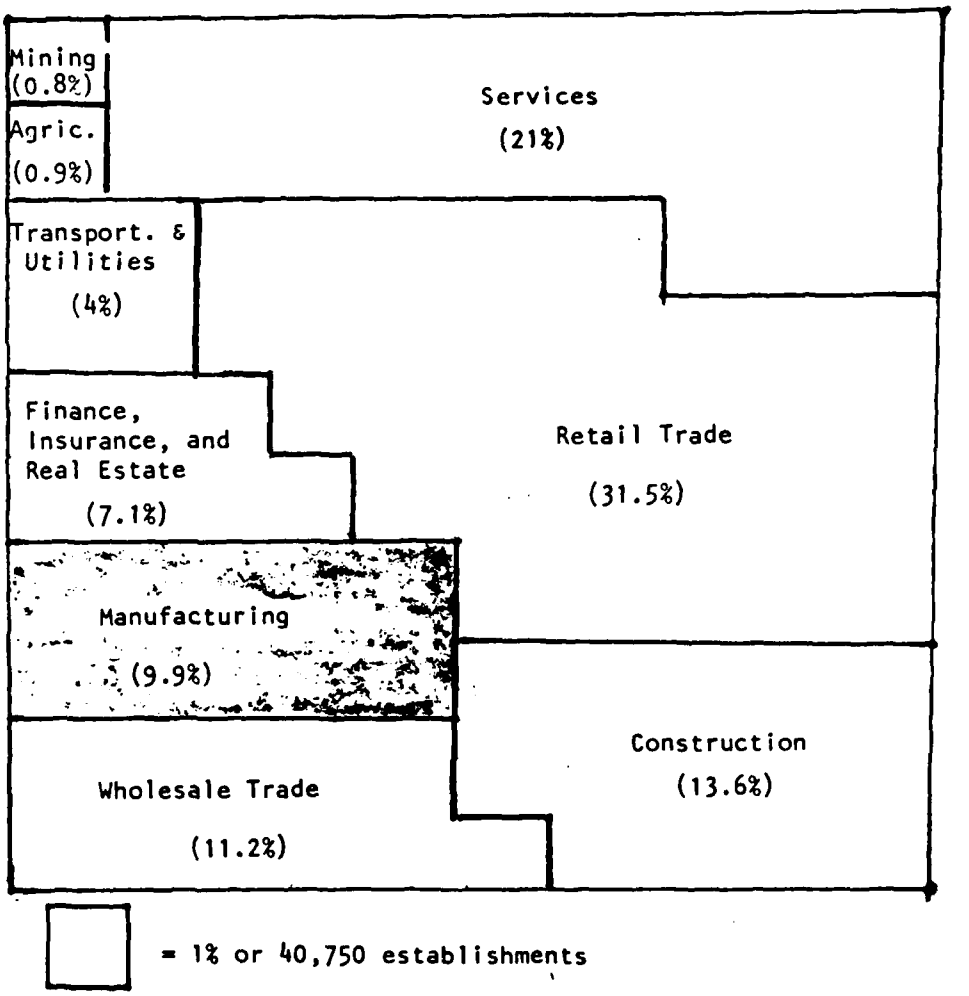
---

* The Standard Industrial Classification (SIC) system is used by the government to report information on businesses. It has various levels. The first digit of an SIC Code refers to the major division category of industries; the second digit refers to major industry groups. The third, fourth and fifth digits of the SIC code narrow the identification to specific industries, sub-industries, and/or products. We use the SIC system throughout this report because it is convenient, easily understood, and widely used. Most of our discussion deals with major industry groups (two digit SIC codes) and specific industries (four digit SIC codes).

EXHIBIT 5

DISTRIBUTION OF SMALL BUSINESSES ACROSS ECONOMIC SECTORS

Total Number of Small Business Establishments = 4,074,981



Data Source: Dun and Bradstreet Market Identifier File, Tabulated for the Small Business Administration by Brookings Instiution, July 1980.

EXHIBIT 6

DISTRIBUTION OF SMALL BUSINESS ESTABLISHMENTS IN MANUFACTURING

SIC Code	Industry	Number of establishments with less than 500 employees	%	Likely to have some investment in metric production
20	Food and kindred	25,439	6.3	
21	Tobacco	191	-	
22	Textile mill	9,443	2.4	
23	Apparel & other textile products	26,527	6.6	
24	Lumber and wood	29,118	7.3	
25	Furniture and fixtures	14,358	3.6	
26	Paper and allied products	7,280	1.8	*
27	Printing and publishing	58,398	14.6	
28	Chemicals and allied products	17,074	4.3	*
29	Petroleum and coal products	2,491	.6	
30	Rubber & misc. plastics	13,052	3.3	*
31	Leather & leather products	3,901	1	
32	Stone clay and glass	19,189	4.8	*
33	Primary metal products	8,418	2.1	*
34	Fabricated metal products	38,677	9.6	*
35	Machinery, except electric	59,652	14.9	*
36	Electric & electronic equipment	20,076	5	*
37	Transportation equipment	11,789	2.9	*
38	Instruments & related products	10,976	2.7	*
39	Miscellaneous manufacturing	24,869	6.2	*
	TOTAL	400,918	100.00	(57.6%)

* Likely to have significant metric activity according to previous surveys and discussions with informed observers.

Data Source: Dun & Bradstreet Market Identifier File, Tabulated for the Small Business Administration by Brookings Institution, July 1980.

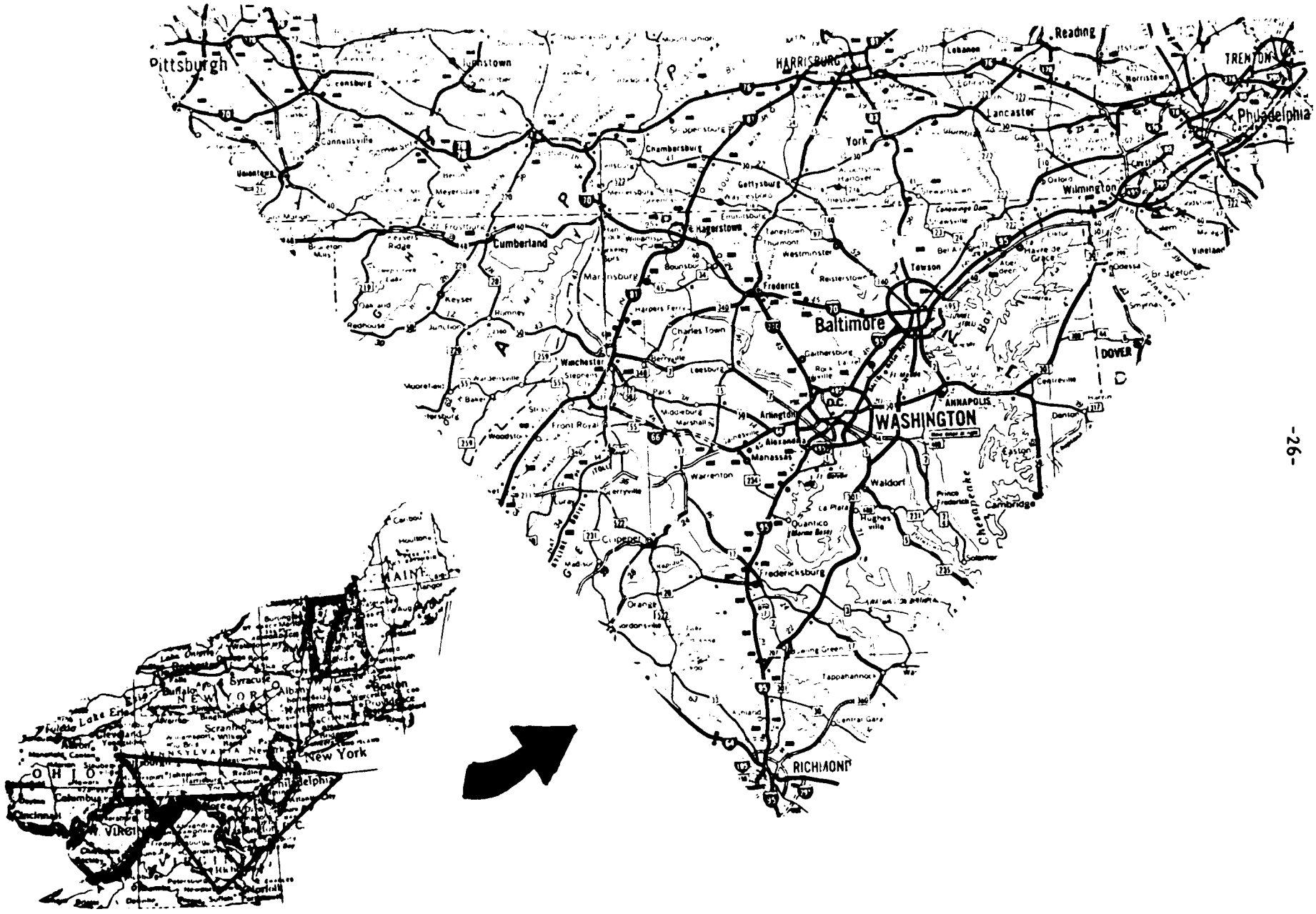
Some of these manufacturing industries were more likely to be making substantial investments in converting to metric. From discussions with USMB, ANMC, and other informed observers, as well as reviews of previous research -- the NBS Metric America study, the GAO review, the ANMC sector status updates, and previous research at USMB, -- the most active areas for metric appear to be industries that make products for other industries -- primary metal products, fabricated metal products, machinery, electrical goods, and the like. Industries dealing with the consumer markets -- food production, apparel, leather products, printing and publishing, were least likely to be metric. Industries dealing in bulk commodities -- such as petroleum and coal or chemicals -- are not likely to have made substantial investments in converting to metric.

In looking for companies making substantial investments in converting to metric, the study concentrated, within manufacturing, on those industries making measurement sensitive products for industries. The right-hand column in Exhibit 6 indicates the industries thought likely to have metric activity involving substantial investments in production. Those industries narrow the search to the 57.6% of the manufacturing establishments contained in SIC codes 26, 28, 30, 32, 33, 34, 35, 36, 37, 38 and 39.

Sorting of small businesses in terms of their likelihood of (a) producing hard metric products and (b) having made substantial investments in converting eliminated 94.3% of all small businesses. However, the remaining 5.7% (231,052 manufacturing establishments) are the most likely to qualify as key companies for in-depth analysis.

Within this limited population of manufacturing establishments, the search concentrated on the Middle Atlantic region. The project team was confident they could contact successful converters and identify key companies for study within this region. Pennsylvania ranks fourth in the nation in the number of manufacturing establishments; Maryland has a diverse industrial population covering over 80% of the SIC codes. The initial searches concentrated on the highly industrial areas in cities within the triangle between Trenton, Pittsburgh, and Richmond (see map.)

THE FOCUS OF THE SEARCHES



The later stages of the search expanded the scope to include other highly industrial states in the Northeast and Midwest -- New York (#2 in number of manufacturing establishments), Massachusetts (#10), New Jersey (#8), Ohio (#5), Michigan (#7) and Illinois (#3) *. The most comprehensive searches for small businesses converting to metric were in Pennsylvania and Maryland; in the other states the search followed leads provided by contacts with other small businesses, the trade press, or large corporations. Overall the search was limited to states east of the Mississippi because (a) the overwhelming majority of manufacturing is in the Northeast and Midwest and (b) the costs of doing several in depth analyses of companies west of the Mississippi would be excessive.

* California is #1 in the number of manufacturing establishments; the cost of an extensive search at that distance was prohibitive.

SEARCHES

The Initial Search

The search for small businesses with significant investments in metric production began with the goal of discussing metric conversion with a few successful converters. The previous small business survey made several interesting observations on conversion. Case reports of metric conversion in ANMC newsletters and pamphlets, the USMB Metric Usage Study and survey of large businesses, the trade press, and the GAO study also described conversion to metric. All fell short, however, of a detailed, comprehensive description of how conversion occurs, the types of costs incurred, and the benefits people see accruing from the conversion. To refine the plan for the in-depth analysis of selected small businesses, the project team needed to talk to some companies that had converted to metric. This was also an opportunity to start gathering possible candidates for future analysis.

For this initial search, businesses in the industrial areas surrounding Baltimore, Philadelphia, Richmond, Pittsburgh, Washington, D.C., and Trenton were contacted. Eight kinds of sources offered leads for the initial search:

- Trade and Business Associations. Following the emphasis of a previous small business survey for USMB on representation, the search involved trade and business associations in Washington and surrounding areas for locating small businesses that had converted to metric. These associations gave general comments about the state of metric conversion in their industries. However, they were not able to identify who among their members had actually converted to metric. Exhibit 7 lists the 30 business and trade associations contacted. These 30 were contacted because they (a) were active in metric planning; (b) had a large number of small business members; (c) were in industries likely to be producing metric products; or (d) were referred by other associations.

- Small Business Administration's Procurement Automated Search System (PASS). PASS is a new data base to assist federal agencies in locating small businesses interested in bidding on federal procurements. Within PASS, there is a subfile of businesses able to supply metric products. To be included on the metric subfile, the business only has to indicate that it has a metric capability. The PASS metric subfile has a total of 25 businesses

EXHIBIT 7

REPRESENTATIONAL ORGANIZATIONS CONTACTED

National Small Business Association
National Federation of Independent Businesses
American National Metric Council
Small Business Administration
National Bureau of Standards
Richmond Chamber of Commerce
Richmond Small Business Administration Office
Smaller Manufacturers Council
Pittsburgh Purchasing Management Association
Small Business Administration, Towson, Md.
Scientific Apparatus Makers Association
American National Standards Institute
American Society for Testing and Materials
National Paint and Coatings Institute
U.S. Chamber of Commerce
Industrial Heating Equipment Association
National Association of Women Business Owners
Printing Industries of America
National Business League
National Association of Home Builders
American Association of Engineering Societies
American Society of Mechanical Engineers
Industrial Fasteners Institute
American Society of Heating, Refrigeration, and Air Conditioning Engineers
National Fasteners Distributors Association
Farm and Industrial Equipment Institute
Massport (State Export Agency)
Small Business Association of New England
Syracuse Chamber of Commerce
Hartford Chamber of Commerce

for the entire country. Of these, ten were in the triangle under consideration. Contacting these ten, only one was a good lead. (Several of the companies had always produced metric products.)

- Metric Yearbooks. J. J. Keller Company publishes a Metric Yearbook reviewing metric events over the past year and discussing conversion in different industries. The yearbooks include case histories of the conversion experiences of businesses. Since most of the businesses discussed are large companies -- over 500 employees -- it was not a useful source.

- National Bureau of Standards and ANMC lists of Metric Suppliers. These were among the best sources for locating small businesses converting to metric. Most of the companies contained in these lists are either large companies or subsidiaries of large companies; a number had always been metric. Nonetheless, they provided several good leads.

- Trade Press (ANMC and USMB press clippings). The best source of leads was the trade press in which companies advertised their metric products. The trade press was especially good for locating small fastener manufacturers and machine shops.

- Newsletter pleas for assistance. Two organizations -- the Smaller Manufacturers Council (Pittsburgh) and the National Association of Women Business Owners, with a combined membership of 1,300 companies, volunteered to run brief pleas for assistance in their newsletters. No companies replied to these solicitations.

- Contacts with businesses. One question asked of large and small businesses contacted in the course of the searches was whether they knew of any other businesses in their industry or in the local area that had converted to metric. For the most part, the large businesses were better sources of businesses than the small businesses. Among the sources, these references were quite good in terms of number and accuracy.

- U.S. Metric Board information files. These files were among the best sources. They are extensive, detailed collections on many phases of metric conversion in the U.S. and elsewhere.

During the initial search, 75 businesses in the Baltimore, Philadelphia, Richmond, and Trenton areas were contacted. When contacted, each company was asked if they were a small business making a substantial investment in converting production to metric dimensions. The following questions were asked to determine if a company met the criteria for

inclusion in the analysis:

--Are you a small company (fewer than 500 employees)?*

--Are you independent, i.e., not a subsidiary?

--Are any of your products or services designed to metric dimensions?

--Have you converted from using customary units to using metric units?

The project team also asked if the decision to convert was a significant corporate decision and whether the investment in converting to the metric system was substantial in their view. If a company passed through these filters, it was a converter and a candidate for being a key company -- one of the companies for in-depth analysis of the costs, benefits, opportunities, and problems of converting to metric.

Additional detailed questions were used in selected cases (a) to help develop the analytical plan, and (b) to determine whether these companies would be suitable as key companies. These detailed questions were organized around six key questions:

- What was converted?
- How was the decision to convert made?
- Why did you convert?
- Did you have any problems -- labor, supplies, inventory?
- Who did you turn to for help?
- Has it paid off?

Exhibit 8 contains the detailed points under each of these key questions.

Early Results

Face-to-face interviews with successful converters were planned. Because of the problems in locating small businesses that had made substantial investments in converting to metric, interviews were conducted by phone. This saved time, increased the number of businesses contacted, and thereby improved the possibility of finding small businesses which had made significant investments. Of the 75 companies contacted, 14 companies

---

* If a company was large (over 500 employees), they were asked if they knew of any small businesses that had converted or if their industry, in general, had converted to metric.

EXHIBIT 8

DETAILED QUESTIONS ON METRIC CONVERSION IN SMALL BUSINESSES

1. WHAT WAS CONVERTED?

What is the nature of your business?
What special things have you changed?
Is your conversion to metric complete?

2. HOW WAS THE DECISION TO CONVERT MADE?

Who made the decision? When?
Were there distinct phases?
Was there a detailed plan?
Who was consulted?
- within the company
- suppliers, customers
- associations and others

Who was involved in the planning?
How was the conversion timed? Why that particular timing?
Why did it end when it did?

3. WHY DID YOU CONVERT?

What were the reasons given?
Were there projections of costs? Are they available?
Were there projections of benefits? Are they available?

4. DID YOU HAVE ANY PROBLEMS?

When did you encounter these problems?
How did you cope with the problems?
- did you have labor problems?
- problems with suppliers?
- problems with customers?
- problems with local government?
- problems with state government?
- problems with federal government?

5. WHOM DID YOU TURN TO FOR HELP?

To whom did you turn for help?
Why did you choose those organizations for assistance?
Was the assistance valuable? Which was the most valuable? Why?
Do people now turn to you for assistance in converting? How do they know about you?

6. HAS IT PAID OFF?

Did conversion cost more or less than expected?
Where were the major discrepancies?
Were the benefits what you expected?
How do you know what the costs and benefits of conversion are?
How has your business changed as a result of conversion?
Would you do it differently if you were starting today? How?
Would you provide your records of the conversion process for study?

had converted to metric. Of these 14, one spent over $10,000 converting to metric. None had spent as much as $50,000. Most companies invested less than $1,000. These results are summarized in Exhibit 9. The idea of $50,000 as a cutoff for substantial investment was clearly out of line with the realities of conversion; $10,000 was a more appropriate figure for substantial investment. The company investing more than $10,000 considered its investment significant.

The initial search yielded several important insights:

- Most companies producing products designed to metric specifications use customary units in the factory or shop. They convert the metric dimensions to customary units and make products using machines calibrated in customary units. For some jobs, especially threading, special metric tools -- taps, dies, lathes, reamers -- are required. Some companies have machinery with both measurement capabilities.

- Most metric production is in response to special orders from customers. Conversion is seen as adding capability they could exercise if and when the need arises. The need seldom arises.

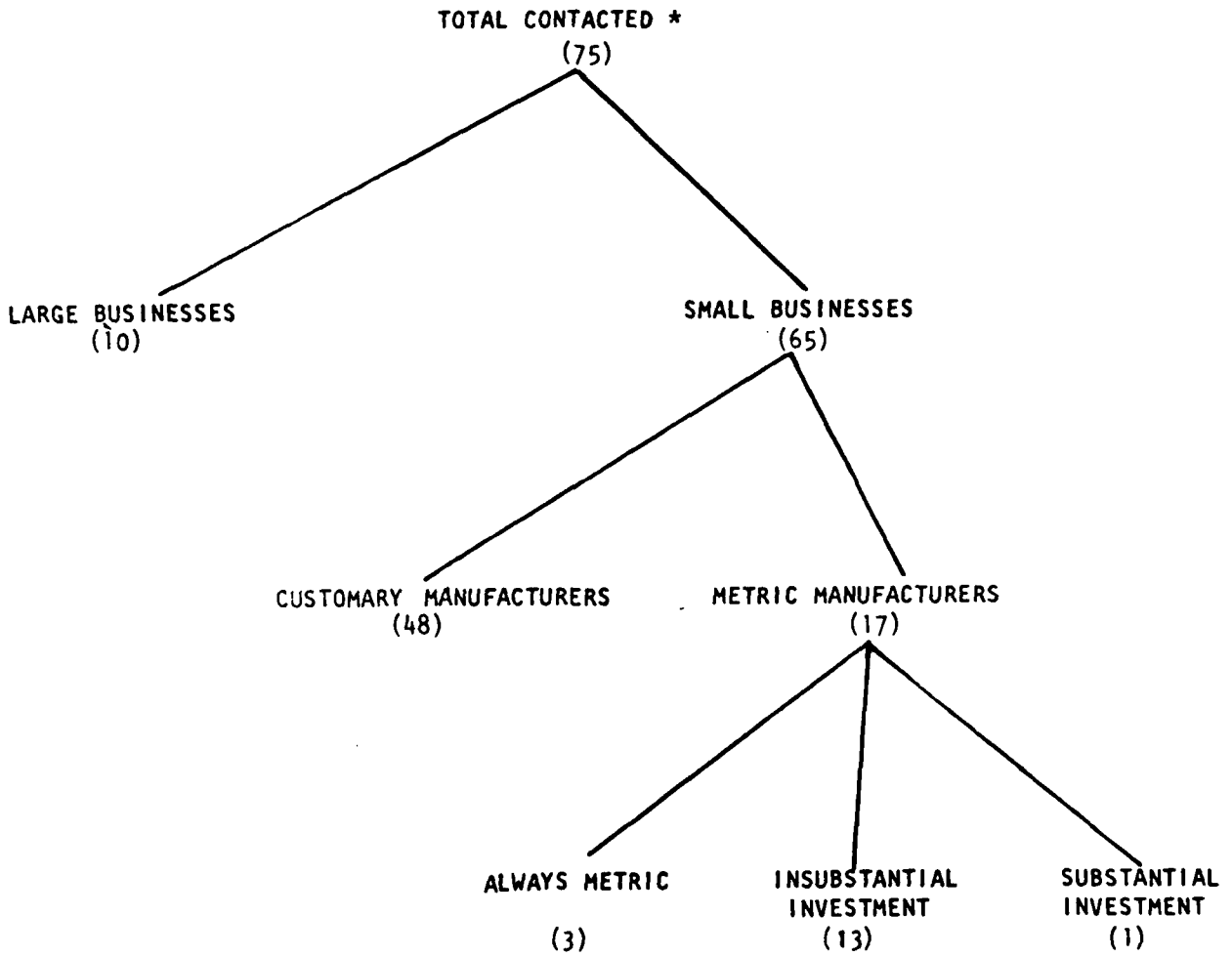
- Companies convert a trivial portion of their operations to metric -- usually less than 5 percent. A few companies supply only metric goods; often these companies were founded for that specific purpose. One of the companies contacted had converted as much as one-third of its operations to metric.

- Given the small percentage of operations converted to metric, the capital investment in conversion is small. Most spent less than $1,000. Only a few spent over $5,000. Most of the money for conversion is spent on items such as special tools, dies, molds, conversion kits for lathes.

- The decision to convert to metric is incremental, of little importance to the firm. For many companies it occurs as a natural outgrowth of the shifting needs of their customers. Few can point to a specific decision to convert. Specific decisions were easiest to find in companies that produce stock metric items. Market research related to conversions is limited to talking to dealers, field representatives, and licensees. At least one company has suffered because of faulty market research on the prospects for its product.

EXHIBIT 9

METRIC ACTIVITY IN BUSINESSES CONTACTED IN INITIAL SEARCH



* Key to Exhibit 9 is on the next page.

The categories in Exhibit 9 are:

Total contacted: Refers to the total number of companies reached during the search. Some companies were not reached because they had moved, gone out of business, or would not accept or return calls. The ratio of attempted contacts to actual contacts is around 3 to 1.

Large businesses: Companies with more than 500 employees are large. A number of the companies reached were subsidiaries or divisions of larger companies; these are large businesses.

Small businesses: Small business is an independent business having fewer than 500 employees in all establishments.

Customary manufacturers: Refers to small companies which produce all their products to customary dimensions. These companies do not work to metric specifications -- even by converting them to customary units.

Metric manufacturers: In this category are all small companies which said they produce products to metric dimensions. This ranges from a company producing all its products in metric dimensions using metric measurements to companies which do only one or two metric orders a year and use customary measurements to fill the orders.

Always metric: A few companies contacted said they had always produced metric items. These companies ranged from companies set up for the sole purpose of making metric products to a machine shop that has always filled metric orders as they have come in.

Insubstantial investment: To be included in this category, the investment in conversion must (a) be considered by the company to be insubstantial, and (b) be less than $10,000. Companies in this category range from those making the continuing minor investment in converting drawings in metric to customary dimension to companies that have purchased up to $10,000 in metric related manufacturing equipment.

Substantial investment: These are the companies the search is looking for. They must be small, independent, metric, converted from customary, have invested over $10,000 or consider their investment substantial.

- The primary motive for converting to metric is keeping existing large corporate customers who have converted to metric.
- Much conversion is spurred by the need to service foreign machinery.
- Few small businesses see that conversion has brought them any additional business. Most companies converted to keep up with the demands of their existing customers.
- Overall, converting to metric has not been a problem for small businesses. Workers are not affected by the change; many are still operating in the customary units. The major problem is getting supplies in metric sizes at economical prices. Confusion of dual inventories -- especially in fasteners -- is also a problem.

Redirection of the Search

To find additional candidates, the search followed two paths. A more systematic and comprehensive search for small businesses was undertaken in Pennsylvania and Maryland; the primary emphasis was on the intensive searches in these two states. Using leads from metric handbooks, trade press, the USMB files, and references from other companies, the search also expanded to a larger area (the Northeast and Midwest).

The purpose of the initial search was to gain insights about the conversion process and locate possible key companies. The searches of Pennsylvania and Maryland were intended solely to locate small businesses that qualified as possible candidates for being key companies -- i.e., small, independent, producing hard metric products, making a substantial investment in converting to metric.

The sources for the search of Pennsylvania and Maryland were the state industrial directories.* These directories are comprehensive lists of manufacturing establishments in the states. In Pennsylvania, the Smaller Manufacturer Council's Classified Directory 1980-1981 was very useful for contacting small businesses in the Pittsburgh area.

---

* Pennsylvania State Industrial Directory (New York: State Industrial Directories Corp., 1981)

Maryland Department of Economic and Community Development. The 1979-1980 Directory of Maryland Manufacturers (Annapolis: State of Maryland, 1979)

The search concentrated on the 11 major industry groups identified as possible areas of metric conversion (see Exhibit 6). Most of these industries manufactured intermediate products -- fabricated metal, measuring instruments, machinery, primary metal products. The industrial directories break each industry into four digit SIC codes. A combination of common sense, advice, and previous research identified which of these four digit SIC codes were useful to contact. The strategy was to cast the net widely but judiciously. To sort among the four digit SIC codes within the selected industries, the project team asked:

- What do others say about conversion in this area? (previous USMB studies, ANMC, trade press, informed observers.)
- Are measurements an important part of their product?
- Do they produce consumer or intermediate goods?
- Does the industry do a large amount of exporting?
- Is it related to other areas known to be metric?

In each of the four digit SIC codes selected, several companies in Maryland and Pennsylvania were contacted to determine if there was any metric activity in that sub-sector of the industry. If these people said they did not produce metric products and their industry was not metric, the search in that SIC code was discontinued. In this way the search was able to cover many industries as well as concentrate on areas most likely to yield possible key companies. When the search encountered metric activity in a SIC code, as many of the companies listed as possible were contacted.

In addition to the intensive searches in Pennsylvania and Maryland, the selective search followed leads in the trade press, USMB files, and ANMC/NBS metric suppliers listings on metric companies in industrial areas in the Northeast -- New York, Connecticut, and Massachusetts. Similar leads were followed into Ohio and Michigan. While these selective searches provided additional insights into metric conversion, they did not yield any substantial small business converters. Most of the people contacted following these leads were divisions of larger companies or had always been metric.

Results of the State Searches

The results of the intensive state searches were revealing in an unexpected way. Out of about 794 phone contacts with businesses in Pennsylvania and Maryland, 4 were small businesses which had made substantial investments -- by their own report or the study's criteria -- in converting to metric. Of the 204 businesses producing metric products (28% of the total contacted), 98% had either made very small investments in converting to metric or had always been metric. Exhibit 10 summarizes the pattern for both states. Exhibits 11 and 12 give the breakdowns for Maryland and Pennsylvania respectively.

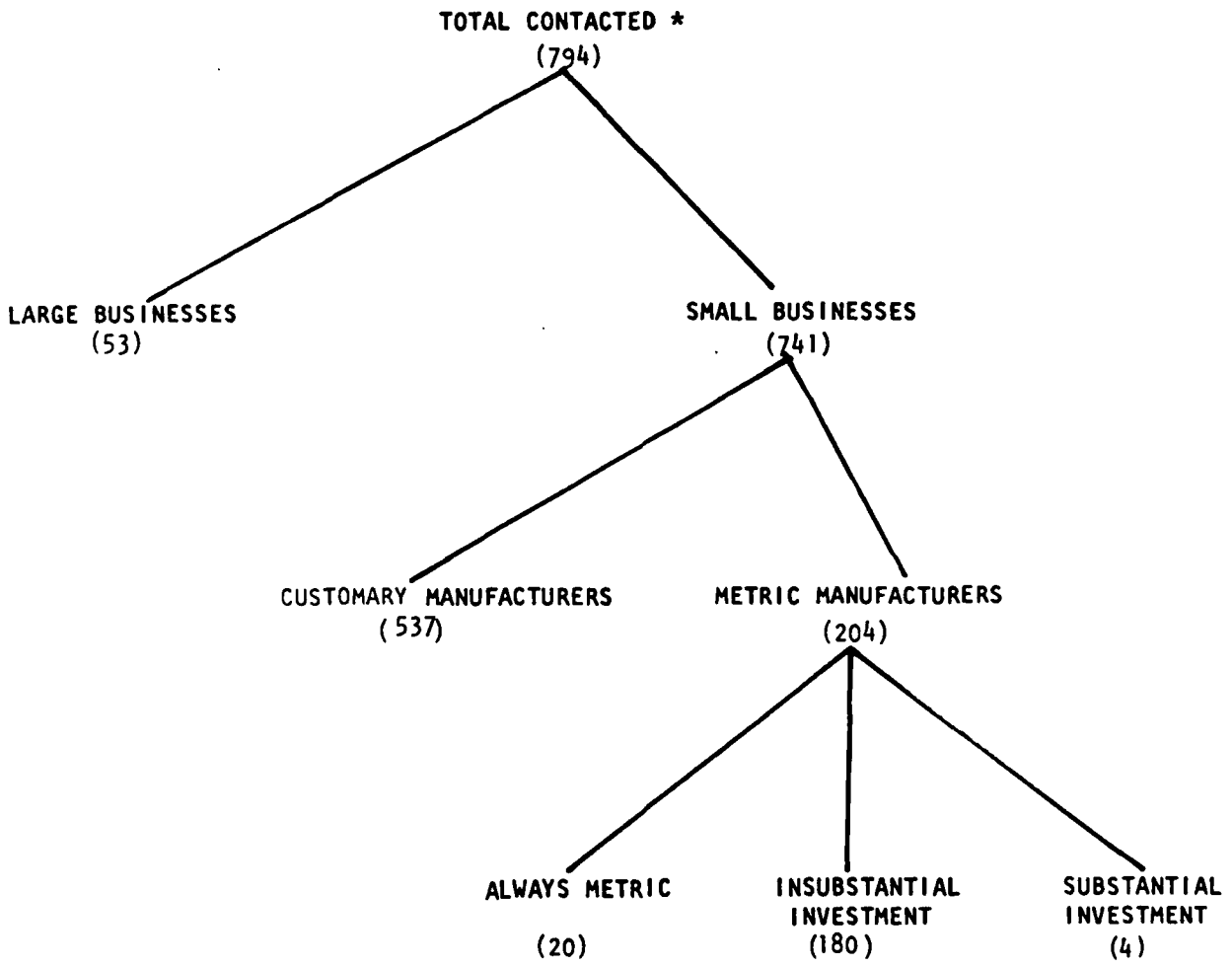
The major areas of conversion are the non-electrical machinery and fabricated metal products industries. The chemical industry has begun to convert its measurements but without a great deal of change in the process of producing chemicals; even the packaging of chemicals remains essentially conventional -- the only difference is that they are filled to metric volumes. The state survey confirmed the earlier conclusions. (See p.33).

From these state searches, several general conclusions emerged:

- Small businesses are not making substantial investments in converting to metric.
- Companies producing metric products have spent very small amounts in developing their metric production capability.
- There is a widespread capability to meet traditional, incremental demand for metric products; major new demands may be difficult to supply.
- Investments in metric production are in response to external pressures -- such as customer demand, or foreign competition. Investments in metric rarely reflect an active search for new markets, ways to improve competitive position, or improvements in the operation of the business.
- The desire for export markets stimulates some conversion; however, only very small investments are made in moving into these foreign markets.

EXHIBIT 10

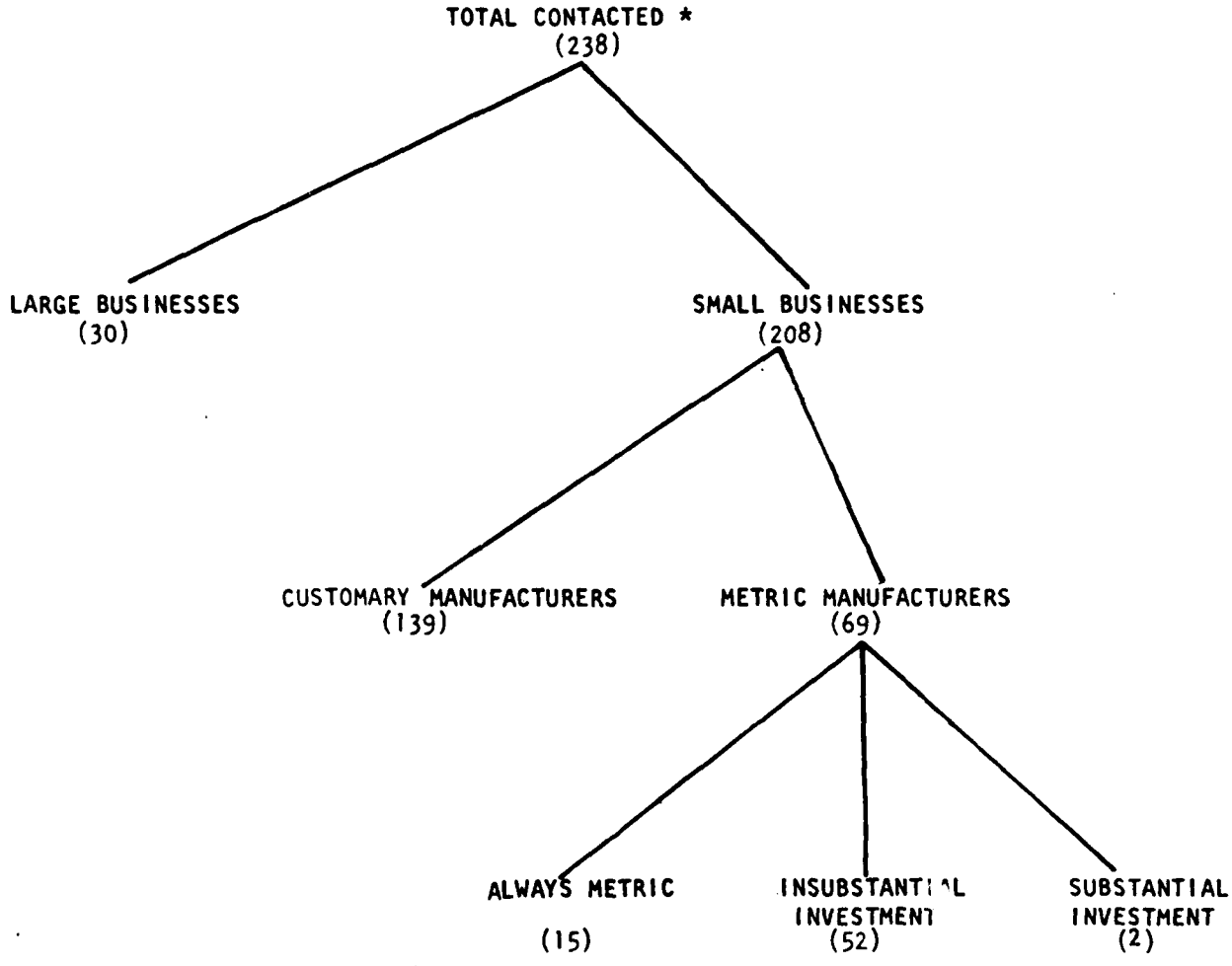
METRIC ACTIVITY IN SMALL BUSINESSES
CONTACTED IN PENNSYLVANIA AND MARYLAND



* See Exhibit 9 for explanation of these categories.

EXHIBIT 11

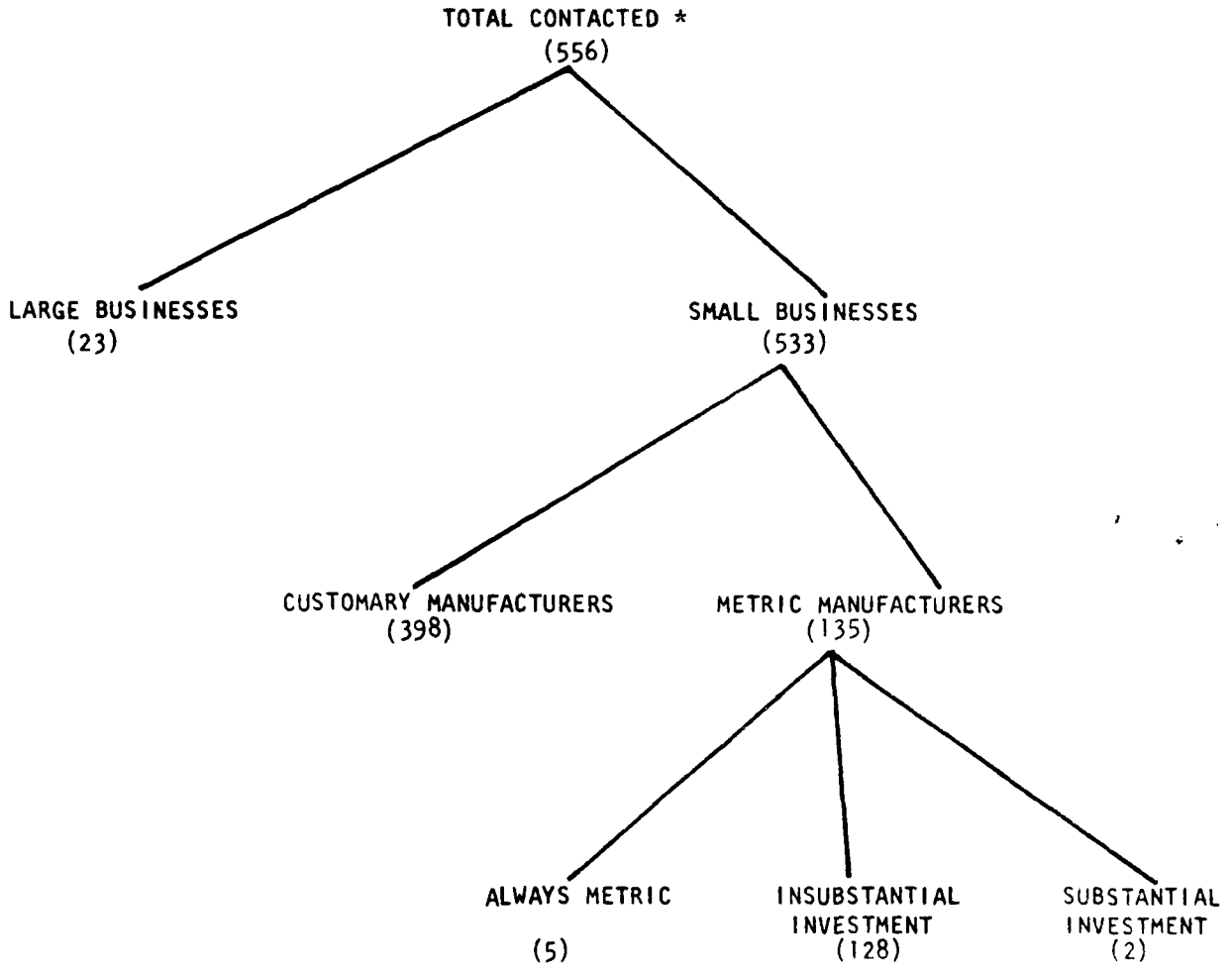
METRIC ACTIVITY IN BUSINESSES CONTACTED IN MARYLAND



* See Exhibit 9 for explanation of these categories.

EXHIBIT 12

METRIC ACTIVITY IN BUSINESSES CONTACTED IN PENNSYLVANIA



* See Exhibit 9 for explanation of these categories.

- The most likely place to find small business making substantial investments in converting to metric are suppliers to large corporations that have converted to metric.

- The companies that had converted to metric were quite cooperative and willing to discuss conversion to the metric system. They had generally positive feelings about the experience -- the sense was that there was no great magic to the process. Few expressed any sense of difficulty in coping with conversion.

- The most hostile responses were from people in industries that were not metric and who saw little possibility that they ever would be metric.

- The costs of metric conversion are associated with the costs of improving the capital stock of the small manufacturing firm. With the introduction of microprocessors, the marginal costs of a metric capability have become negligible.

Small Business Metric Suppliers to Large Businesses

Since only four substantial investors were found in the state searches, the next search strategy was to turn to large businesses in earnest for the names of small businesses that supplied them with metric products. In the previous searches large companies incidentally contacted were asked if they used any small business suppliers of metric products. As the search progressed, it became apparent that much of small businesses' conversion was a result of demands from large companies. This observation was strongly supported by the Small Business Advisory Group of the American National Metric Council.

The intensive search for small business metric suppliers of large businesses began with a review of the USMB survey of Fortune 1000 companies' metric activity. Question 1 of that survey asked if the company purchased materials and supplies in metric; 34 large companies out of the 119 companies responding to the question were purchasing materials and supplies in metric. Contacting several of these companies, they were able to identify several metric small business suppliers. With this encouraging result, the search for small businesses supplying metric products to large corporations began in earnest.

The American National Metric Council assisted the search for small business suppliers to large companies by sending letters to nine Fortune 500 companies requesting their assistance in the search. Six of the companies were able to give names of small businesses who supply them with metric products. The success of the ANMC letters and the contacts with the respondents to the large company survey led to increased efforts to locate small businesses through large businesses. Following the pattern of previous searches, multiple sources were used to identify large businesses to contact. Among the sources we the Fortune 500 list of businesses, advertisements in the trade press, ANMC newsletters and reports on metric activity, the J.J. Keller metric yearbooks, leads from other large businesses, and the USMB survey of large businesses.

The search in this phase contacted approximately 200 large companies. Half of these companies were Fortune 500 companies -- mostly in the top 250. The responses of these large companies fell into two categories -- either they made all their own metric materials or they had several suppliers of metric products -- mostly small businesses. Among those companies that used outside metric suppliers, few were able to easily identify the suppliers. In most corporations, purchasing decisions are very decentralized; there is rarely a central repository of information on the suppliers to the large company. This is especially true of the extremely large companies. Several of these companies took time to ask around and develop a list of small business suppliers. Others identified one or more divisions that they knew were producing in metric dimensions.

The large companies provided leads to 92 metric suppliers. In some cases they did not know whether the company was large or small. Of the 92 mentioned, a third were large companies. A number of people in the large companies gave names of companies they thought might be making metric products. Another 26 small companies stated they did not make any metric products. Even the lists that people drew up over the period of a couple of weeks contained some companies that only produced customary products.

Of the 36 suppliers who did provide metric products to the large companies, 27 had made insubstantial investments -- most of these were fastener manufacturers, metal stampers, container manufacturers, and companies making electrical machinery. Only two had made substantial investments -- over $10,000 -- in converting to metric. Exhibit 13 summarizes the distribution of responses from contacts with suppliers of large businesses.

Contacts with the large metric companies and their suppliers lead to three observations:

- Large corporations are using smaller businesses to produce metric items. It is often necessary to talk to several people to get a comprehensive picture of the large corporation's use of small businesses in supplying metric parts.

- For even the major converters to metric -- such as the automobile and agricultural equipment manufacturers -- metric is not a prominent activity. It is down in the noise.

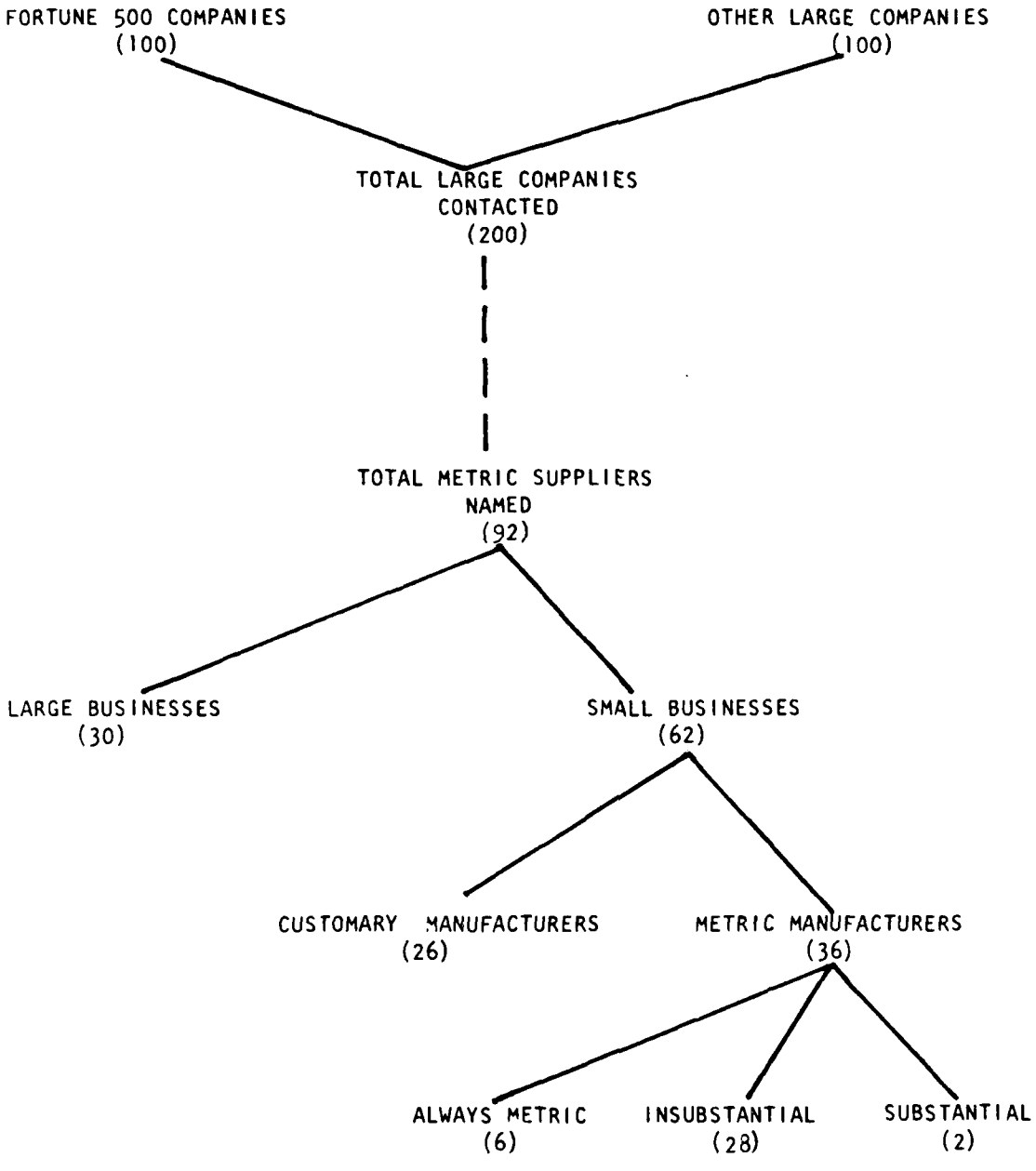
- There is often a symbiotic relationship between a large corporation and its suppliers regarding metric products, developed out of mutual self interest. For example many large companies provide conversion factors with their metric drawings because they know the small businesses are using conventional equipment. They provide the factor to insure the part is made to their specifications. In some cases the large company will buy the mold or casting for a metric part and give it to the small business to use in producing its supplies. This is to insure the part is made to the proper dimensions and is used only for the large company's products. In either case mutual self-interest leads to minimal disruption in the production of hard metric products.

Small Business Survey Revisited

The search for small key businesses making substantial investments in converting began by following high probability leads in a specific geographical area. As the search progressed several of the initial constraints -- geographical location, size of investment considered substantial, and independence from the demands of large customers -- were relaxed. In addition the search supplemented high probability leads with more comprehensive searches in areas that had some possibility of producing

EXHIBIT 13

METRIC ACTIVITY IN SUPPLIERS TO LARGE COMPANIES PRODUCING METRIC PRODUCTS



metric products. The final approach was to relax the criterion of avoiding companies which had been studied before by turning to the previous survey of small businesses.

As part of the previous survey of small businesses, companies were asked if they developed products in metric sizes. They were also asked the percentage of their companies' products that were non-metric, soft metric, hard metric, or hybrid metric. Exhibit 14 summarizes the sorting of the responses to the first small business study; only the manufacturing companies were sorted. Of the 227 manufacturers who responded, over one-fourth made some metric products. These 60 companies split between those that produce only soft metric products and those companies that made hard or hybrid metric products. The percentages under each of the headings in Exhibit 14 represent the percentages of each type of metric product reported by the respondents falling under that heading.

Letters were sent to 30 companies making hard or hybrid products which responded to the small business survey to see if they would be willing to participate in this subsequent phase of the research. Of the 15 responses to this solicitation, 3 agreed to urther discussion of metric. None of these companies made a substantial investment in metric production. *

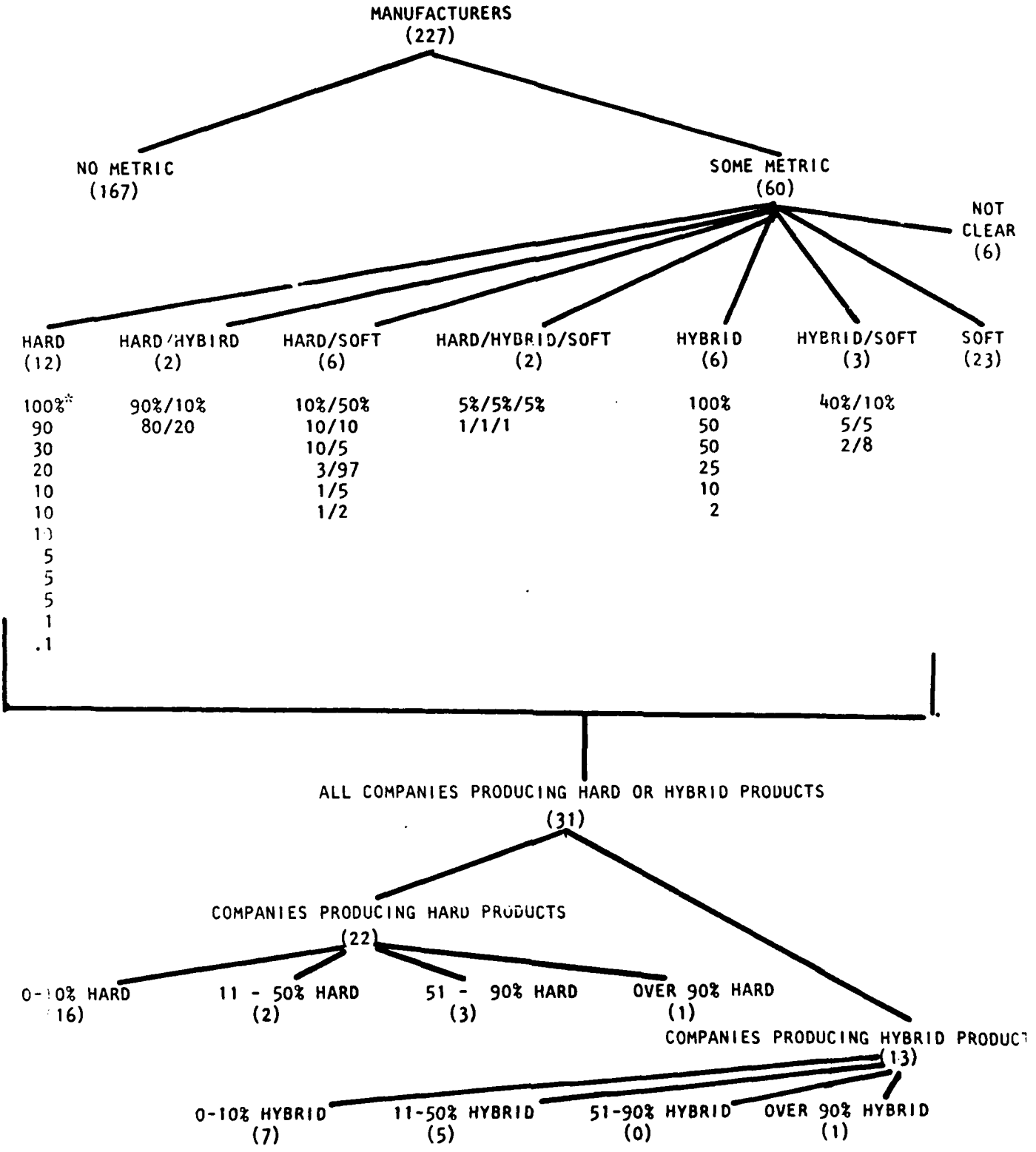
From the previous searches and the re-examination of previous survey results on manufacturing small businesses, the project team came to three additional conclusions:

- The findings of these searches generally support the conclusions of the previous survey:
  - the primary motivation is customer demand.
  - few problems are encountered with conversion.
  - a routine approach to conversion prevails.
- These searches found about the same proportion of small manufacturers producing hard metric products as the previous survey. Using a stratified random sample, the previous survey found 26% of manufacturing small businesses produce hard metric products. This report's non-random searches found 30% of small business manufacturers producing hard metric products.

* These three unproductive contacts are not included in the overall totals of businesses, small businesses, or metric small businesses contacted.

EXHIBIT 14

MANUFACTURERS' PATTERN OF RESPONSES TO SMALL BUSINESS SURVEY:
TYPE AND PERCENTAGE OF METRIC PRODUCTS



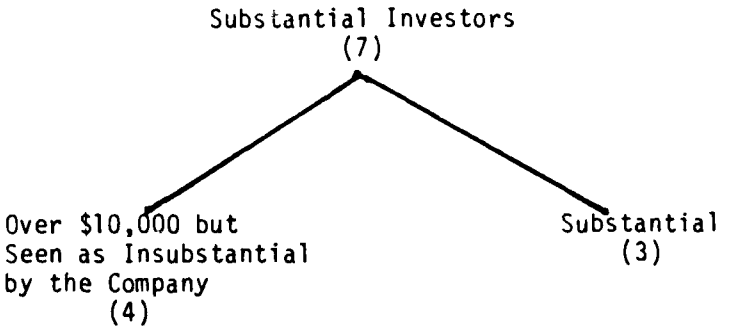
* Percentage of respondent's products that are hard, hybrid, or soft metric.

- The previous survey reports of a "modest but significant" amount of metric conversion among all small businesses.

- For manufacturing, "modest but significant" is a major overstatement. Review of the first survey's data reveals that most companies produce less than 10% of their products in metric. Many produce less than 5%. This minor amount of metric production coincides with the study's finding of a widespread but shallow capability; less than 1% of the 161 companies contacted made a substantial investment in converting to metric.

Substantial Investors Revisited

The search for small businesses which have made substantial investments in conversion to metric revealed that seven companies, 0.8% of the 868 small companies contacted, met the criteria of having made a substantial investment and successfully metricated. Those seven companies were the subject of more in-depth study concerning their investments, the relative importance of the investment to the company, the problems encountered in conversion, and other aspects of conversion. From contacts with these it was found that:



Vignettes of the conversion experiences of the three substantial investors are presented in Exhibits 15 and 16. The experiences of the other four are similar to those of the insubstantial investors described throughout this report.

EXHIBIT 15

VIGNETTE A: SUBSTANTIAL INVESTMENTS IN CONVERTING MARKING EQUIPMENT TO METRIC

XYZ Marking Corporation*

XYZ makes equipment to stamp labels on stainless steel silverware, rolled steel, or other steel products. For use overseas, these machines must be able to accept metric dimensions as well as to produce metric lettering.

About 15-20% of their business is metric, solely in response to demands from overseas customers. They have actively sought this overseas business for the last 8-10 years. At first, XYZ worked in metric only sporadically; lately, it has been more continuous, producing new metric machinery and making replacement parts for their older metric machinery. They usually sell their metric products to foreign contractors who are building plants overseas.

Their costs for producing metric marking machines primarily come from converting the dials on several of their machines, around $2,000 for ten machines, and from purchasing a computer-controlled milling machine for $40,000. While this machine can also produce to customary dimensions, it is primarily used (70%) for metric production. The costs for conversion are around $60,000 by their estimate.

XYZ has more than 50 and less than 100 employees. Their average yearly expenditure on new capital equipment is between $50,000 and $100,000. Their metric investment is between 10% and 20% of their five year capital expenditures.

They have had few problems converting to metric. Their biggest problems were in the beginning when they had to make a few machines over because of mistakes in production. That is no longer a major problem.

They converted voluntarily to get the overseas business. They do not see everyone in their industry going to metric.

* We have changed the names of the companies because they have not had the opportunity to review, modify, or revise these accounts.

EXHIBIT 16

VIGNETTE B: SUBSTANTIAL INVESTMENT IN CONVERTING BOTTLING TO METRIC

ABC Bottlers

ABC bottles a soft drink for a large conglomerate, its only customer. They rely on the conglomerate for all the R&D and management costs; the conglomerate tells them what they want done and how they want it done.

The one and two liter bottles are big sellers in the soft drink market. ABC was able to use existing filling equipment to fill these sizes. However, ABC has spent $70,000 converting other aspects of its bottling line to take on the one and two liter size bottles.

A key point here is that these are regular costs for any conversion to any different bottle size. About one-half the cost ($30,000) was for a decaser -- a device that removes the empty bottles from their case. Their old decaser can only handle glass bottles; one and two liter bottles are plastic. According to ABC, the fact that the new bottles are metric means nothing to the bottler, only that they are plastic and a different size.

ABC has less than 50 employees. They spend about $100,000 a year on new capital equipment or between one-half and one million dollars over five years. Their investment in metric is thus between 7% and 14% of five year capital investments.

EFG Bottlers

EFG Bottlers bottles many kinds of soft drinks for many different customers. They do not make the bottles or the contents; they only put the drink in the bottles. A growing proportion of their business involves metric size bottles. The one and two liter bottles are a hot item in the soft drink industry.

To keep up with the industry trend, EFG bought a $200,000 machine that would fill two liter bottles. Some companies could change existing equipment to fill the two liter bottles; EFG could not.

EFG Bottlers has between 100 and 200 employees. They spend an average of $200,000 a year on new capital equipment or one million over five years, making the investment in the filler 20% of a five year investment.

They had no problems with the conversion.

To get a better idea of the costs involved in bottle conversion, we interviewed a manufacturer of bottling machinery.

Bottling Machines, Inc.

Bottling Machines made EFG's two liter filling machine. According to Bottling Machines, the fact that it is for a two liter bottle is not a key point. It is a question of large versus small bottles. If a machine only fills small bottles, you either need to buy a machine that fills large bottles (half gallon or two liter) or convert your small machine, possibly by using every other spout so it can accommodate the larger bottles. It does not matter whether the large bottle is 64 ounces or two liters; the key distinction is large or small. To put the two liter bottle on a 64 ounce line, there might be $5,000 of changed parts for the bottle filler and other routine change costs up and downstream on the bottling line.

Contacts with these "substantial investors" lead to some further conclusions:

- The percentage of small businesses making substantial investment in metric is less than 1% of those contacted.
- It is difficult to isolate what costs are strictly related to metric. All three substantial investors purchased machinery that accommodates customary as well as metric measurements. They bought the machines for their metric business but could use the machine for their customary work.
- The three substantial investors spent between 10% and 20% of their estimates of their five-year capital investment in converting to metric. The other four companies spent less than 5%.
- Much of conversion for the seven investors depends on servicing foreign machinery.
- The seven split about evenly between those that converted to seek export markets and those that converted to hold their customers' business.
- Even among substantial investors, there is still a large amount of work in customary units in the factory.
- Much of the production by seven substantial investors is hybrid, metric to fit with foreign metric machines but customary in internal structure.

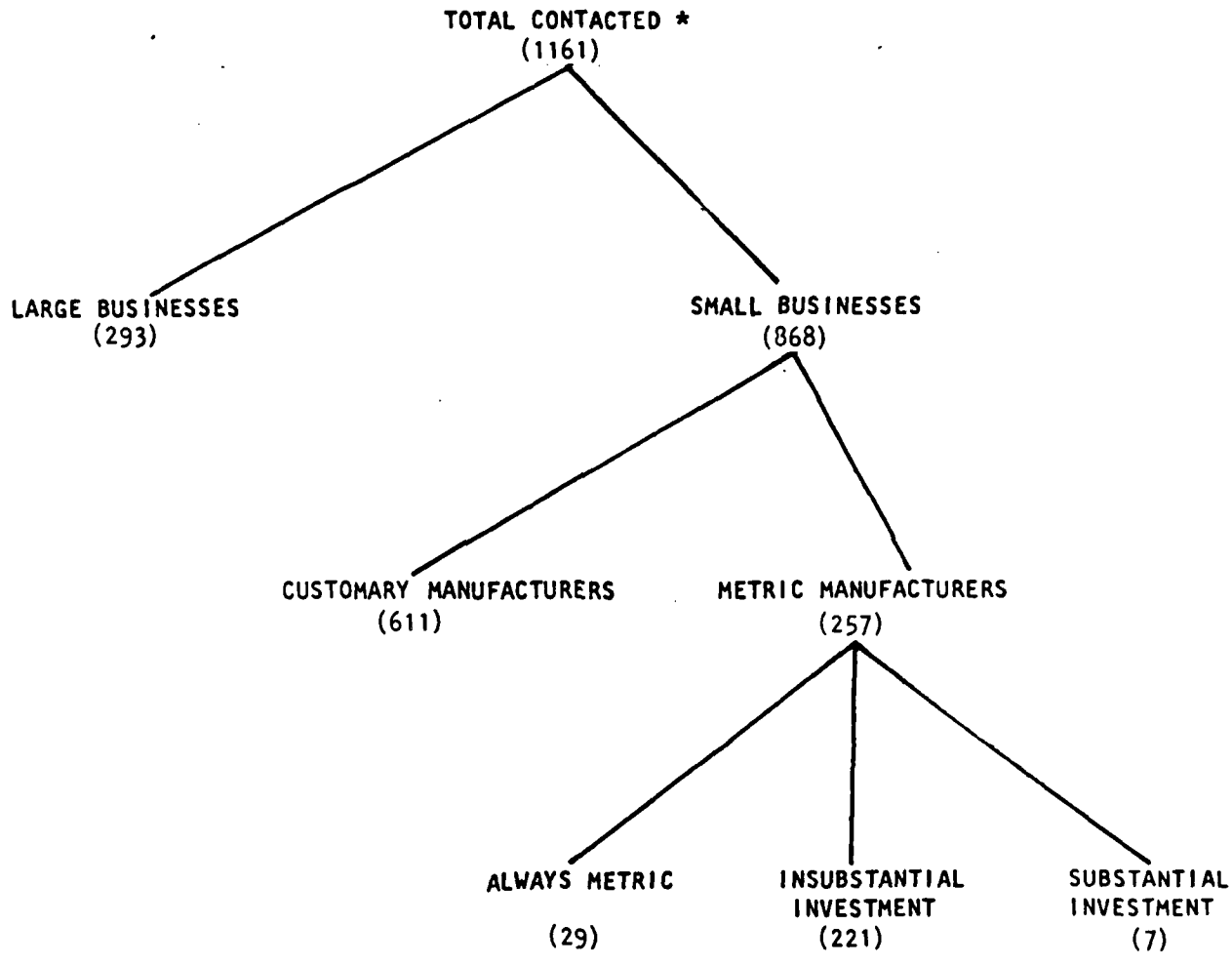
Overall Findings

From contacts with 1,161 companies, three general findings emerge:

- Seven of every ten small companies contacted worked only in customary units. (See Exhibit 17.) Any orders received and any products produced are measured in customary units.
- Of the 257 metric companies contacted, the overwhelming majority produced metric products on the basis of insubstantial investments. In some cases the investments were for tools -- taps, dies, micrometers, lathe screws, gauges. In other cases the investments represented the time spent converting the occasional metric order into customary units for production on customary machinery; while the product was metric, the process was customary.
- Fewer than 1% of the small companies contacted claimed a substantial investment in converting.

EXHIBIT 17

DISTRIBUTION OF RESPONSES TO ALL SEARCHES



* See Exhibit 9 for explanation of these categories.

While the primary purpose of the search was to locate key companies for subsequent research, information was gathered on the status of conversion in different manufacturing industries. Eleven industry groupings within manufacturing were searched, which the evidence suggested would be most likely to have metric activity. Early in the search it became clear that chemical production was not likely to be a source of substantial investment in conversion; the key costs for metric conversion in the chemical industry are in changing sc'es and associated billing and ordering forms. Any conversion of packaging for the chemical industry would show up in the paper and allied products industry or the fabricated metal products industry.

Companies in 108 of the 236 four digit SIC codes covered by the remaining 10 manufacturing industries were contacted. Most of the codes covered were in fabricated metal products (major industry group 34), machinery - except electrical (35), measuring instruments (group 38), transportation equipment (37), primary metals (33), paper and allied products (26), and electrical and electronic machinery. The four digit SIC codes not covered were (a) dominated by large corporations in the areas we searched (motor vehicle and passenger car bodies - SIC 3711, for example); (b) not covered in the sources used for the searches (typewriters - SIC 3572, for example); or (c) were not considered likely to have substantial metric activity (games, toys, and children's vehicles -- except dolls and bicycles, SIC 3944, for example).

The status of conversion, as reflected by contacts with small and large businesses in manufacturing industries is presented in Exhibit 18. The exhibit is organized by 4 digit SIC codes. The left hand column lists all the codes for the major industry groups that were covered (see Exhibit 6). The next column lists the specific industries (4 digit codes) in which companies were contacted. Following that is a column giving the project team's judgment on whether there is some (M), little (m), or no (C) metric activity. The remaining three columns indicate what others have said about the presence or possibility of conversion in the specific industry.

The GAO study of the implications of the adoption of the metric system was used throughout the analysis to gain insights on the costs and benefits of conversion.* It was not incorporated into Exhibit 18 for several reasons:

- The report did not lend itself to easy interpretation of the status of conversion in the different industries. General phrases such as "mixed," "little demand," or "just beginning" were used frequently. It was not clear if these descriptions referred to planning or production.
- The industries discussed cover only a portion of the manufacturing SIC codes considered in this analysis.
- The comments on status of conversion were quite similar across industries -- little or no activity.

A brief review of the table indicates a sizeable amount of metric activity in the machinery and fabricated metal products industries. Significant conversion is also taking place in the rubber and plastics industries. There was less conversion than expected in the transportation, instruments, and electrical machinery sectors. Primary metals revealed a large amount of conversion activity. It should be noted that these observations are based on contacts with a few companies in each industry -- mostly in Pennsylvania and Maryland. Further investigation of the status of conversion in different industries could be useful to the USMB's mission.

A summary of conclusions from this study was presented at the beginning of tnis report.

*U.S. General Accounting Office, Getting a Better Understanding of the Metric System - Implications if Adopted by the United States. CED-78-128 (Washington, D.C.: U.S. Government Printing Office, October 20, 1978).

EXHIBIT 18

LEVEL OF METRIC ACTIVITY IN SELECTED INDUSTRIES: RESULTS FROM SEARCHES

MANUFACTURING INDUSTRIES LIKELY TO HAVE METRIC ACTIV.	MANUFACTURING INDUSTRIES CONTACTED IN OUR SEARCH	REPORTS OF METRIC ACTIVITY			
		OUR SEARCH	NBS	ANMC	USMB FILES
26 PAPER AND ALLIED PRODUCTS				L	
261 Pulp Mills					
2611 Pulp mills					
262 Paper Mills, Except Building Paper					
2621 Paper mills, except building paper					
263 Paperboard Mills					
2631 Paperboard mills	2631-Paperboard mills	C			X
264 Misc. Converted Paper Products					
2641 Paper coating and glazing					
2642 Envelopes	2643-Bags, exc. textile	C			
2643 Bags, except textile bags					
2645 Die-cut paper and board	2645-Die-cut paper/board	C			X
2646 Pressed and molded pulp goods					
2647 Sanitary paper products					
2648 Stationery products					
2649 Converted paper products, nec	2649-Converted paper prod	C			X
265 Paperboard Containers and Boxes					
2651 Folding paperboard boxes	2651-Folding pap. boxes	C			
2652 Set-up paperboard boxes					
2653 Corrugated and solid fiber boxes					
2654 Sanitary food containers					
2655 Fiber cans, drums & similar products	2655-Fiber cans, drums...	C			X
266 Building Paper and Board Mills					
2661 Building paper and board mills					
28 CHEMICALS AND ALLIED PRODUCTS	28-Chemicals/Allied Prod. (see text)	m		H	X
30 RUBBER AND MISC. PLASTICS PRODUCTS					
301 Tires and Inner Tubes					
3011 Tires and inner tubes	3011-Tires & Inner tube.	M			
302 Rubber and Plastics Footwear					
3021 Rubber and plastics footwear					
303 Reclaimed Rubber					
3031 Reclaimed rubber					
304 Rubber and Plastics Hose and Belting	3041-Rubber/plas. hose...	M			
3041 Rubber and plastics hose and belting					
306 Fabricated Rubber Products, nec					
3069 Fabricated rubber products, nec					
307 Miscellaneous Plastics Products	3079-Misc. Plas. prods.	M			
3079 Miscellaneous plastics products					

more →

KEY

OUR SEARCH: M = some metric activity; several companies produce hard metric products; insubstantial investment

m = little metric activity; one or two companies produce hard metric products; produce metric using customary units.

C = Products produced and measured in customary units; some dual labelling but for all pruposes no metric production.

NBS: * = Included in the list of industries likely to be affected by metric conversion contained in U.S. Metric Study report The Manufacturing Industry (1971).

ANMC: Letters refer to High, Medium, or Low levels of sector planning according to ANMC Sector Status Update (4/81).

USMB FILES: X = a review of material in USMB files indicates some metric activity. This activity ranges from hard metric products to dual labelling or planning future conversion. This listing is more inclusive than our M, m, C categorization.

EXHIBIT 18 (Continued)

LEVEL OF METRIC ACTIVITY IN SELECTED INDUSTRIES: RESULTS FROM SEARCHES

MANUFACTURING INDUSTRIES LIKELY TO HAVE METRIC ACTIV.	MANUFACTURING INDUSTRIES CONTACTED IN OUR SEARCH	REPORTS OF METRIC ACTIVITY			
		OUR SEARCH	NBS	ANMC	USMB FILES
32 STONE, CLAY, AND GLASS PRODUCTS					
321 Flat Glass					
3211 Flat glass					
322 Glass and Glassware, Pressed or Blown					
3221 Glass containers	3221-Glass containers	M	*		X
3229 Pressed and blown glass, nec					
323 Products of Purchased Glass					
3231 Products of purchased glass					
324 Cement, Hydraulic					
3241 Cement, hydraulic	3241-Cement, hydraulic	C			X
325 Structural Clay Products					
3251 Brick and structural clay [illegible]					
3253 Ceramic wall and floor tile					
3255 Clay refractories					
3259 Structural clay products, nec					
326 Pottery and Related Products					
3261 Vitreous plumbing fixtures					
3262 Vitreous china food utensils					
3263 Fine earthenware food utensils					
3264 Porcelain electrical supplies					
3269 Pottery products, nec					
327 Concrete, Gypsum, and Plaster Products					
3271 Concrete block and brick					
3272 Concrete products, nec					
3273 Ready-mixed concrete					
3274 Lime					
3275 Gypsum products					
328 Cut Stone and Stone Products					
3281 Cut stone and stone products					
329 Misc. Nonmetallic Mineral Products					
3291 Abrasive products					
3292 Asbestos products					
3293 Gaskets, packing and sealing devices	3293-Gaskets, packing...	m			
3295 Minerals, ground or treated					
3296 Mineral wool					
3297 Nonclay refractories					
3299 Nonmetallic mineral products, nec					
33 PRIMARY METAL INDUSTRIES				M	
331 Blast Furnace and Basic Steel Products					
3312 Blast furnaces and steel mills	3312-Blast furnaces/mills	C	*		X
3313 Electrometallurgical products	3313-Elect-metal. prods.	m	*		
3315 Steel wire and related products					
3316 Cold finishing of steel shapes	3316-Cold finishing	m	*		
3317 Steel pipe and tubes	3317-Steel pipes/tubes	C	*		
332 Iron and Steel Foundries					
3321 Gray iron foundries					
3322 Malleable iron foundries					
3324 Steel investment foundries					
3325 Steel foundries, nec	3325-Steel foundries nec	C			
333 Primary Nonferrous Metals					
3331 Primary copper					
3332 Primary lead					
3333 Primary zinc					
3334 Primary aluminum					
3339 Primary nonferrous metals, nec					
334 Secondary Nonferrous Metals					
3341 Secondary nonferrous metals	3341-Secondary Nonferr...	C			
335 Nonferrous Rolling and Drawing					
3351 Copper rolling and drawing	3351-Copper rolling/draw.	m	*		
3353 Aluminum sheet, plate, and foil	3353-Alum. sheet/plate...	C			
3354 Aluminum extruded products	3354-Alum. extruded prod.	C			
3355 Aluminum rolling and drawing, nec	3355-Alum. rolling/draw.	C			
3356 Nonferrous rolling and drawing, nec	3356-Nonfer. rolling/draw.	m	*		
3357 Nonferrous wire drawing & insulating	3357-Nonfer. wire draw...	C	*		
336 Nonferrous Foundries					
3361 Aluminum foundries	3361-Alum. foundries	M	*		
3362 Brass, bronze, and copper foundries	3362-Brass/bronze/copper	M	*		
3369 Nonferrous foundries, nec	3369-Nonfer. foundries	m	*		
339 Miscellaneous Primary Metal Products					
3398 Metal heat treating					
3399 Primary metal products, nec					

more →

EXHIBIT 18 (Continued)

LEVEL OF METRIC ACTIVITY IN SELECTED INDUSTRIES: RESULTS FROM SEARCHES

MANUFACTURING INDUSTRIES LIKELY TO HAVE METRIC ACTIV.	MANUFACTURING INDUSTRIES CONTACTED IN OUR SEARCH	REPORTS OF METRIC ACTIVITY			
		OUR SEARCH	NBS	ANMC	USMB FILES
34 FABRICATED METAL PRODUCTS					
341 Metal Cans and Shipping Containers					
3411 Metal cans	3411-Metal cans	M	*		Y
3412 Metal barrels, drums, and pails	3412-Metal barrels, drum.	C			
342 Cutlery, Hand Tools, and Hardware					
3421 Cutlery					
3423 Hand and edge tools, nec	3423-Hand/edge tools nec	C			
3425 Hand saws and saw blades	3425-Hand saws/blades	m			
3429 Hardware, nec	3429-Hardware nec	M			
343 Plumbing and Heating, Except E					
3431 Metal sanitary ware					
3432 Plumbing fittings and brass goods					
3433 Heating equipment, except electric	3433-Heating equip....	M	*		
344 Fabricated Structural Metal Products					
3441 Fabricated structural metal	3441-Fab. struc. metal	m	*		Y
3442 Metal doors, sash, and trim	3442-Metal doors, sash...	C	*		Y
3443 Fabricated plate work (boiler shops)	3443-Fab. plate work	M	*		Y
3444 Sheet metal work	3444-Sheet metal work	M	*		Y
3446 Architectural metal work					
3448 Prefabricated metal buildings					
3449 Miscellaneous metal work	3449-Misc. metal work	m	*		Y
345 Screw Machine Products, Bolts, etc.					
3451 Screw machine products	3451-Screw mach. prods.	m	*		
3452 Bolts, nuts, rivets, and washers	3452-Bolts, nuts,...	M	*		Y
346 Metal Forgings and Stampings					
3462 Iron and steel forgings					
3463 Nonferrous forgings					
3465 Automotive stampings	3465-Automotive stampings	M			
3466 Crowns and closures	3466-Crowns & closures	M			
3469 Metal stampings, nec	3469-Metal stampings nec	M			
347 Metal Services, nec					
3471 Plating and polishing					
3479 Metal coating and allied services	3479-Metal coating/svcs.	C			
348 Ordnance and Accessories, nec					
3482 Small arms ammunition					
3483 Ammunition, exc. for small arms, nec					
3484 Small arms					
3489 Ordnance and accessories, nec					
349 Misc. Fabricated Metal Products					
3493 Steel springs, except wire	3493-Steel springs,...	m			
3494 Valves and pipe fittings	3494-Valves/pipe fittings	C	*		Y
3495 Wire springs	3495-Wire springs	C			
3496 Misc fabricated wire products	3496-Misc. fab. wire prod	C			
3497 Metal foil and leaf					
3498 Fabricated pipe and fittings	3498-Fab. pipe/fittings	C	*		
3499 Fabricated metal products, nec	3499-Fab. metal prods.	m			

more →

EXHIBIT 18 (Continued)

LEVEL OF METRIC ACTIVITY IN SELECTED INDUSTRIES: RESULTS FROM SEARCHES

MANUFACTURING INDUSTRIES LIKELY TO HAVE METRIC ACTIV.	MANUFACTURING INDUSTRIES CONTACTED IN OUR SEARCH	REPORTS OF METRIC ACTIVITY			
		OUR SEARCH	NBS	ANMC	USMB FILES
35 MACHINERY, EXCEPT ELECTRICAL				H	
351 Engines and Turbines					
3511 Turbines and turbine generator sets					
3519 Internal combustion engines, nec					
352 Farm and Garden Machinery					
3523 Farm machinery and equipment	3523-Farm mach. & equip.	M	*		X
3524 Lawn and garden equipment	3524-Lawn/garden equip.	C			
353 Construction and Related Machinery					
3531 Construction machinery	3531-Construction mach.	C	*		X
3532 Mining machinery	3532-Mining mach.	m	*		
3533 Oil field machinery	3533-Oil field mach.	C	*		X
3534 Elevators and moving stairways					
3535 Conveyors and conveying equipment	3535-Conveyors & equip.	M	*		X
3536 Hoists, cranes, and monorails					
3537 Industrial trucks and tractors					
354 Metalworking Machinery					
3541 Machine tools, metal cutting types	3541-Mach. tools,cutting	M	*		X
3542 Machine tools, metal forming types	3542-Mach. tools, forming	m	*		y
3544 Special dies, tools, jigs & fixtures	3544-Spec. dies, tools...	M	*		X
3545 Machine tool accessories	3545-Mach. tool acces.	m			
3546 Power driven hand tools	3546-Power driven hand t.	M			
3547 Rolling mill machinery	3547-Rolling mill mach.	M			
3549 Metalworking machinery, nec	3549-Metal working mach.	m	*		
355 Special Industry Machinery					
3551 Food products machinery	3551-Food products mach.	C	*		X
3552 Textile machinery					
3553 Woodworking machinery	3553-Woodwork mach.	C	*		X
3554 Paper industries machinery	3554-Paper ind. mach.	C	*		X
3555 Printing trades machinery	3555-Printing ind. mach.	C	*		X
3559 Special industry machinery, nec	3559-Spec. ind. mach.	M	*		X
356 General Industrial Machinery					
3561 Pumps and pumping equipment	3561-Pumps and equip.	C	*		X
3562 Ball and roller bearings	3562-Ball & roller ...	M	*		X
3563 Air and gas compressors	3563-Air & Gas compressors	M	*		X
3564 Blowers and fans	3564-Blowers & Fans	C	*		X
3565 Industrial patterns	3565-Ind. patterns	M	*		X
3566 Speed changers, drives, and gears	3566-Speed changers...	M	*		X
3567 Industrial furnaces and ovens	3567-Ind. furnaces/ovens	m	*		X
3568 Power transmission equipment, nec	3568-Power transmissions	C			y
3569 General industrial machinery, nec	3569-Gen. ind. mach.	M	*		
357 Office and Computing Machines					
3572 Typewriters					
3573 Electronic computing equipment					
3574 Calculating and accounting machines					
3576 Scales and balances, exc. laboratory	3576-Scales & balances	M	*		X
3579 Office machines, nec	3579-Office machines	C	*		
358 Refrigeration and Service Machinery					
3581 Automatic merchandising machines					
3582 Commercial laundry equipment					
3585 Refrigeration and heating equipment	3585-Refrig. & heating	C	*		X
3586 Measuring and dispensing pumps					
3589 Service industry machinery, nec	3589-Serv. ind. mach.	m	*		X
359 Misc. Machinery, Except Electrical					
3592 Carburetors, pistons, rings, valves	3592-Carburetors, pistons	C	*		
3599 Machinery, except electrical, nec	3599-Mach. exc. elect.	M	*		

more →

EXHIBIT 18 (Continued)

LEVEL OF METRIC ACTIVITY IN SELECTED INDUSTRIES: RESULTS FROM SEARCHES

MANUFACTURING INDUSTRIES LIKELY TO HAVE METRIC ACTIV.	MANUFACTURING INDUSTRIES CONTACTED IN OUR SEARCH	REPORTS OF METRIC ACTIVITY			
		OUR SEARCH	NBS	ANMC	USMB FILES
36 ELECTRIC AND ELECTRONIC EQUIPMENT				L/M	
361 Electric Distributing Equipment					
3612 Transformers					
3613 Switchgear and switchboard apparatus					
362 Electrical Industrial Apparatus					
3621 Motors and generators					
3622 Industrial controls	3622-Industrial controls	m	*		
3623 Welding apparatus, electric					
3624 Carbon and graphite products					
3629 Electrical industrial apparatus, nec					
363 Household Appliances					
3631 Household cooking equipment	3631-Household cooking	C	*		X
3632 Household refrigerators and freezers					
3633 Household laundry equipment					
3634 Electric housewares and fans					
3635 Household vacuum cleaners					
3636 Sewing machines					
3639 Household appliances, nec					
364 Electric Lighting and Wiring Equipment					
3641 Electric lamps					
3643 Current carrying wiring devices					
3644 Noncurrent-carrying wiring devices	3644-Noncur. carrying...	m	*		
3645 Residential lighting fixtures					
3646 Commercial lighting fixtures					
3647 Vehicular lighting equipment					
3648 Lighting equipment, nec					
365 Radio and TV Receiving Equipment					
3651 Radio and TV receiving sets					
3652 Phonograph records					
366 Communication Equipment					
3661 Telephone and telegraph apparatus	3661-Tel. & Tel. apparat.	C			
3662 Radio and TV communication equipment	3662-Radio & TV comm.	C	*		X
367 Electronic Components and Accessories					
3671 Electron tubes, receiving type					
3672 Cathode ray television picture tubes					
3673 Electron tubes, transmitting					
3674 Semiconductors and related devices	3674-Semiconductors...	C	*		
3675 Electronic capacitors					
3676 Electronic resistors					
3677 Electronic coils and transformers	3677-Elec. coils & trans.	m			
3678 Electronic connectors	3678-Electronic connect.	m			
3679 Electronic components, nec	3679- " components	m	*		
369 Misc. Electrical Equipment & Supplies					
3691 Storage batteries					
3692 Primary batteries, dry and wet					
3693 X-ray apparatus and tubes	3693-X-ray apparatus	C			
3694 Engine electrical equipment					
3699 Electrical equipment & supplies, nec	3699-Elec. equip/supply	C			
37 TRANSPORTATION EQUIPMENT				L	
371 Motor Vehicles and Equipment					
3711 Motor vehicles and car bodies					
3713 Truck and bus bodies	3713-Truck & Bus bodies	C	*		X
3714 Motor vehicle parts and accessories	3714-Motor Veh. parts...	m	*		X
3715 Truck trailers					
372 Aircraft and Parts					
3721 Aircraft					
3724 Aircraft engines and engine parts					
3728 Aircraft equipment, nec	3728-Aircraft equip.	C	*		X
373 Ship and Boat Building and Repairing					
3731 Ship building and repairing					
3732 Boat building and repairing					
374 Railroad Equipment					
3743 Railroad equipment	3743-Railroad equip.	C			
375 Motorcycles, Bicycles, and Parts					
3751 Motorcycles, bicycles, and parts					
376 Guided Missiles, Space Vehicles, Parts					
3764 Guided missiles and space vehicles					
3769 Space propulsion units and parts					
3769 Space vehicle equipment, nec	3769-Space veh. equip.	C			
379 Miscellaneous Transportation Equipment					
3792 Travel trailers and campers	3792-Travel trailers...	C	*		
3795 Tanks and tank components					
3799 Transportation equipment, nec					

more →

EXHIBIT 18 (Continued)

LEVEL OF METRIC ACTIVITY IN SELECTED INDUSTRIES: RESULTS FROM SEARCHES

MANUFACTURING INDUSTRIES LIKELY TO HAVE METRIC ACTIV.	MANUFACTURING INDUSTRIES CONTACTED IN OUR SEARCH	REPORTS OF METRIC ACTIVITY			
		OUR SEARCH	NBS	ANMC	USMB FILES
38 INSTRUMENTS AND RELATED PRODUCTS				H	
381 Engineering & Scientific Instruments					
3811 Engineering & scientific instruments	3811-Eng. & Sci. Inst.	C	*		Y
382 Measuring and Controlling Devices					
3822 Environmental controls					
3823 Process control instruments	3823-Process Control Inst	m			X
3824 Fluid meters and counting devices	3824-Fluid meters...	m			X
3825 Instruments to measure electricity	3825-Inst./measure elec.	m		▼	X
3829 Measuring & controlling devices, nec	3829-Measuring & Control.	C		L	X
383 Optical Instruments and Lenses					
3832 Optical instruments and lenses					
384 Medical Instruments and Supplies					
3841 Surgical and medical instruments	3841-Surg. & Med. Inst.	C	*		X
3842 Surgical appliances and supplies					
3843 Dental equipment and supplies	3843-Dental Equip/Supply	m	*	▼	X
385 Ophthalmic Goods					
3851 Ophthalmic goods					
386 Photographic Equipment and Supplies					
3861 Photographic equipment and supplies					
387 Watches, Clocks, and Watchcases					
3873 Watches, clocks, and watchcases					
39 MISCELLANEOUS MANUFACTURING INDUSTRIES					
391 Jewelry, Silverware, and Plated Ware					
3911 Jewelry, precious metal					
3914 Silverware and plated ware					
3915 Jewelers' materials & lapidary work					
393 Musical Instruments					
3931 Musical instruments					
394 Toys and Sporting Goods					
3942 Dolls					
3944 Games, toys, and children's vehicles					
3949 Sporting and athletic goods, nec					
395 Pens, Pencils, Office and Art Supplies					
3951 Pens and mechanical pencils					
3952 Lead pencils and art goods					
3953 Marking devices	3953-Marking Devices	M			
3955 Carbon paper and inked ribbons					
396 Costume Jewelry and Notions					
3961 Costume jewelry					
3962 Artificial flowers					
3963 Buttons					
3964 Needles, pins, and fasteners					
399 Miscellaneous Manufactures					
3991 Brooms and brushes					
3993 Signs and advertising displays					
3995 Burial caskets					
3996 Hard surface floor coverings					
3999 Manufacturing industries, nec	3999-Mfg. Indus., nec	M			


DATE:
TIME